ENERGY PLAN 1985

A Discussion Document

May, 1986

Nova Scotia

Department of Mines and Energy

Honourable Joel R. Matheson, Q.C.
Minister

MINISTER'S MESSAGE

Energy Plan, 1985 is intended to contribute to an informed discussion of the energy challenges and opportunities facing Nova Scotia in the next decade and beyond. It outlines the broad policy options available to the province to achieve our planning objectives of **energy stability** and **economic development**. Through it, we are seeking input from all sectors of our economy respecting these options and the maximizing of our energy potential.

Substantial progress has been made in realizing our objectives since the initial Energy Plan in 1979. Yet it is important to note that we are still more dependent on oil than other parts of Canada, and that our long-term forecasts respecting oil pricing and supply are comparable to those underlying the 1979 Energy Plan. There is no reason for the province to change direction in mid-stream and there is considerable danger inherent in such a course. Given that conventional reserves of oil in non-OPEC countries are declining, there is a strong possibility that the conditions existing in 1973 and 1979 could re-emerge by the 1990's, a very short time in the world of energy resource development.

This Plan, completed late last year, is based on data and information available at that time. Already it has seen the dramatic decline in world oil prices, the encouraging discovery of oil off our coast and the decision by Sydney Steel Corporation to proceed with an electric arc furnace. While those events have altered some of the assumptions underlying the analysis, they have not changed the basic thrust or validity of the policy options being put forward.

Energy stability in our province can only be achieved if our energy planning is based on the most likely situation facing us in the medium to long-term. Reaction to short-term events can be accommodated through the flexibility built into our policies and the diversity built into our initiatives.

Economic development in the province can be significantly influenced by our energy policies. This report clearly indicates that we have the resources and the ability to achieve a competitive, efficient provincial energy mix and to become a net exporter of energy. This objective will result in significant employment and business opportunities for Nova Scotians. These opportunities will come directly through the energy projects themselves, and indirectly, through investment attracted to our province by the secure supply of the various fuels and energy sources that will be available.

As stated, I hope that this Plan will stimulate discussion of the options by which we can influence our energy future. The input of interested parties on the issues covered in this publication is an important element in our policy formulation process.

Joel R. Matheson

Joel R. Matheson, Q.C.
Minister of Mines and Energy
May 1986

ENERGY PLAN, 1985

TABLE OF CONTENTS

SUMMARY

INTRODUCTION SUMMARY - 1

PROGRESS TO DATE SUMMARY - 2
  Conserving Energy 3
  Substituting for Oil 3
  Developing Indigenous Supplies 5
  Developing Provincial Expertise 5
  Ensuring Secure Supplies 5
  Providing for Energy Cooperation 6

CURRENT SITUATION SUMMARY - 7

THE PROVINCE'S ENERGY RESOURCES SUMMARY - 10
  Coal 10
  Offshore Gas and Oil 10
  Tidal and River Hydro 11
  Forest Biomass 11
  Peat 11
  Municipal Solid Waste 12
  Onshore Petroleum and Natural Gas 12
  Renewable Energy Sources 12
  Imported Oil 12
  Electricity 13
  Energy Efficiency 13

FORECASTS SUMMARY - 15
  "Status Quo" Case 15
  "Target" Case 17

POLICY OPTIONS SUMMARY - 21
  Energy Management 21
  New Production and Consumption Technologies 21
  Fuel Selection 22

CONCLUSIONS SUMMARY - 26

TITLE	PAGE HEADING	PAGE
1. THE ENERGY ENVIRONMENT		1
1.0 Introduction	INTRODUCTION	1
1.1 The International Stage	INTERNATIONAL	4
Background		4
Oil Pricing and Economic Growth		4
The Situation in 1979		5
Where the Forecasts Went Wrong		5
The Effect on OPEC		6
The Present Situation		7
The Dangers of a Sudden Price Drop		9
The Effects of Currency Fluctuations		10
The Possibility of Growing Demand		10
How Long Will Supply Expand		11
The Limits to Planning		12
Summary		13
1.2 The National Scene	CANADA	15
Background		15
The National Strategy		15
Background to the NEP		16
The NEP		16
Natural Gas Under the NEP		18
Energy as an Economic Engine		18
The Dangers with Projections		19
1982 - 1984		19
The Western Accord		21
The Deregulation of Natural Gas Pricing		22
Decontrol Replaces Regulation		23
Canada Remains a Net Exporter...		24
...And A High Intensity Consumer		24
Where the Country Stands		25
Summary		30
1.3 The Provincial Environment	NOVA SCOTIA	31
Background		31
The NEP and Nova Scotia		31
Nova Scotia was an Anomaly in its Dependence on Imported Oil		32
Demand was More Consistent with National Patterns		32
The Objectives of the 1979 Energy Plan		33
Conservation		33
Oil Substitution		35
Developing Indigenous Energy Supplies		36
Developing Provincial Expertise		38

TITLE	PAGE HEADING	PAGE
Ensuring Secure Supplies	NOVA SCOTIA	39
Providing for Energy Cooperation		40
Where the Province Stands		40
1.4 Conclusion		43
2. THE PROVINCE'S RESOURCES		46
2.0 Introduction		46
2.1 Natural Resources	NATURAL RESOURCES	47
Coal		47
Offshore Gas and Oil		52
River and Tidal Hydro		56
Forest Biomass		58
Peat		60
Municipal Solid Waste (MSW)		62
Onshore Petroleum and Oil Shales		62
Uranium		63
Renewable Energy Sources		63
Imported Oil		65
Electricity		69
2.2 Energy Efficiency	ENERGY EFFICIENCY	72
Overview		72
Residential Sector		73
Industrial and Commercial/Institutional Sectors		77
Transportation Sector		79
2.3 The Status Quo Case	THE STATUS QUO CASE	83
Introduction		83
Philosophy and Description of the "Status Quo" Case		84
Sectoral Energy Demand Forecasts		85
Residential Sector		85
Commercial/Institutional/Public Administration Sector		87
Industrial Sector		90
Transportation Sector		92
Total End-Use Energy Demand		94
Primary Energy Demand		95
Supply/Demand Balance		98
Coal		98
Crude Oil		99
Natural Gas		99
Natural Gas Liquids		100

TITLE	PAGE HEADING	PAGE
Forest Biomass	THE STATUS QUO CASE	101
Hydro Power		101
Municipal Solid Wastes, Wind, Solar		102
Total Supply/Demand Balance		102
2.4 Conclusion		103
3. THE TARGET CASE		104
3.0 Introduction		104
3.1 The Target Case	THE TARGET CASE	105
Target Case Sectoral Energy Demand Forecasts		106
Residential Sector		106
Commercial/Institutional/Public Administration Sector		107
Industrial Sector		109
Transportation Sector		111
Total End-Use Energy Demand		112
Primary Energy Demand		114
Policy Options Available		117
Selection Criteria		117
3.2 Recommended Policy Options	POLICY OPTIONS	119
Energy Efficiency		119
New Production and Consumption Technologies		122
Coal Technologies		122
Coal Liquefaction		122
Fluidized Bed Combustion		124
Coal-Liquid Mixtures		124
Natural Gas Technologies		125
Natural Gas from Coal Seams (Demethanation)		125
CNG or Natural Gas Vehicles		125
Electric Technologies		125
Large-Scale Heat Pumps		125
Electric Duct or Plenum Heaters		126
Fuel Selections		126
Electricity		126
Forest Biomass		128
Indigenous Natural Gas, Gas Liquids and Crude Oil Products		130
Coal		132
Other Fuels		134
Peat		135
Municipal Solid Waste		135
Solar Power		136
Residual Fuel Sources		136
Target Case Primary Energy Supply/Demand Balance		137

TITLE	PAGE HEADING	PAGE
3.3 Summary and Implications of The Target Case	SUMMARY AND IMPLICATIONS	139
Economic Impacts		141
Environmental Implications		144
Conclusion and Course of Action		146

Appendix A - Nova Scotia Coal Resources

Appendix B - Assumptions: Status Quo Scenario

Appendix C - Assumptions: Target Scenario

Appendix D - Conversion Factors

LIST OF FIGURES

	TITLE AND SOURCE	PAGE
1-1	WORLD OIL PRICES AND CONSUMPTION, 1973-1984 BP Statistical Review of World Energy, June 1985, pp. 8, 12, 13.	6
1-2	PRICES FOR ARABIAN LIGHT OIL, 1973-1984 BP Statistical Review of World Energy, June 1985, pp. 13.	7
1-3	WORLD CONSUMPTION OF OIL AND OF TOTAL PRIMARY ENERGY 1979 AND 1984 BP Statistical Review of World Energy, June 1985, pp.7	11
1-4	WORLD OIL PRODUCTION, 1960-1984 The National Energy Program Update 1982, pp. 11. BP Statistical Review of World Energy, June 1985, pp. 4.	11
1-5	WORLD OIL PRODUCTION: CAPACITY AND RESERVES, 1984 BP Statistical Review of World Energy, June 1985, pp. 2, 5. Nova Scotia Deparment of Mines and Energy	12
1-6	WORLD OIL PRICE PROJECTIONS Canadian Energy Supply and Demand, 1983-2005, Technical Report, National Energy Board, September 1984, pp. 1, 7.	13
1-7	CANADIAN OIL SUPPLY AND DEMAND: EFFECT OF NEP The National Energy Program, 1980, pp. 9, 99.	16
1-8	IMPORTED AND DOMESTIC CRUDE OIL PRICES, 1970-1984 Nova Scotia Department of Mines and Energy	17
1-9	EASTERN CANADIAN AND EXPORT GAS PRICES AS A PERCENTAGE OF CANADIAN OIL PRICES, 1973-84 The National Energy Program, 1980, pp. 32 Nova Scotia Department of Mines and Energy	18
1-10	OIL PRICES AND CANADIAN CONSUMPTION, 1973-1985 BP Statistical Review of World Energy, June 1985, pp. 8, 12. Nova Scotia Department of Mines and Energy	21
1-11	MONTREAL REFINERY ACQUISITION COST OF ALBERTA "OLD OIL" BEFORE AND AFTER DEREGULATION Nova Scotia Department of Mines and Energy	22

	TITLE AND SOURCE	PAGE
1-12	ENERGY INTENSITY OF SELECTED COUNTRIES Nova Scotia Department of Mines and Energy	26
1-13	CANADIAN END-USE ENERGY DEMAND BY FUEL: HISTORICAL AND PROJECTED Canadian Energy Supply and Demand, 1983-2005, Technical Report, National Energy Board, September 1984, pp. 37	26
1-14	CANADIAN PRIMARY ENERGY PRODUCTION BY FUEL: HISTORICAL AND PROJECTED Canadian Energy Supply and Demand, 1983-2005, Technical Report, National Energy Board, September 1984, pp. 103	27
1-15	CANADA: ENERGY FLOWS, 1982 Canadian Energy Supply and Demand, 1983-2005, Technical Report, National Energy Board, September 1984, pp. 97	27
1-16	CANADA: END-USE ENERGY DEMAND BY SECTOR: HISTORICAL AND PROJECTED Canadian Energy Supply and Demand, 1983-2005, Summary Report, National Energy Board, September 1984, pp. 5	29
1-17	1979 ENERGY PLAN: END-USE ENERGY PROJECTIONS COMPARED TO ACTUAL (1984) Nova Scotia Department of Mines and Energy	34
1-18	PRIMARY ENERGY CONSUMPTION BY FUEL, NOVA SCOTIA AND CANADA, 1979 and 1984 Nova Scotia Department of Mines and Energy Energy Information Handbook; Energy, Mines and Resources, pp. 2.2A and 2.2B	41
2-1	MAJOR COALFIELDS IN NOVA SCOTIA Nova Scotia Department of Mines and Energy	47
2-2	SIGNIFICANT HYDROCARBON DISCOVERIES NEAR SABLE ISLAND Nova Scotia Department of Mines and Energy	54
2-3	PEATLAND CONCENTRATION REGIONS IN NOVA SCOTIA Nova Scotia Department of Mines and Energy	61
2-4	NOVA SCOTIA REFINED PETROLEUM PRODUCT SALES, 1979 AND 1984 Nova Scotia Department of Mines and Energy	66

TITLE AND SOURCE PAGE

2-5 MARKET SHARES OF REFINED PETROLEUM PRODUCTS, NOVA SCOTIA, 1979 and 1984 67
Nova Scotia Department of Mines and Energy
Figure 2-4

2-6 NOVA SCOTIA POWER CORPORATION GENERATING STATIONS 70
Nova Scotia Department of Mines and Energy
Nova Scotia Power Corporation

2-7 NOVA SCOTIA: END-USE ENERGY CONSUMPTION 1979-84, RESIDENTIAL SECTOR 75
Nova Scotia Department of Mines and Energy

2-8 NOVA SCOTIA: END-USE ENERGY CONSUMPTION 1979-84, INDUSTRIAL AND COMMERCIAL/INSTITUTIONAL SECTORS 78
Nova Scotia Department of Mines and Energy

2-9 NOVA SCOTIA: END-USE ENERGY CONSUMPTION 1979-84, TRANSPORTATION SECTOR 80
Nova Scotia Department of Mines and Energy

2-10 STATUS QUO CASE: RESIDENTIAL END-USE ENERGY DEMAND, 1984-2005 86
Nova Scotia Department of Mines and Energy

2-11 STATUS QUO CASE: COMMERCIAL/INSTITUTIONAL END-USE ENERGY DEMAND, 1984-2005 89
Nova Scotia Department of Mines and Energy

2-12 STATUS QUO CASE: INDUSTRIAL END-USE ENERGY DEMAND, 1984-2005 91
Nova Scotia Department of Mines and Energy

2-13 STATUS QUO CASE: TRANSPORTATION END-USE ENERGY DEMAND, 1984-2005 93
Nova Scotia Department of Mines and Energy

2-14 STATUS QUO CASE: TOTAL END-USE ENERGY DEMAND, 1984-2005 95
Nova Scotia Department of Mines and Energy

2-15 STATUS QUO CASE: TOTAL PRIMARY ENERGY DEMAND, 1984-2005 97
Nova Scotia Department of Mines and Energy

3-1 TARGET CASE: RESIDENTIAL END-USE ENERGY DEMAND, 1985-2005 107
Nova Scotia Department of Mines and Energy

	TITLE AND SOURCE	PAGE
3-2	TARGET CASE: COMMERCIAL AND INSTITUTIONAL END-USE ENERGY DEMAND, 1985-2005 Nova Scotia Department of Mines and Energy	108
3-3	TARGET CASE: INDUSTRIAL END-USE ENERGY DEMAND, 1985-2005 Nova Scotia Department of Mines and Energy	110
3-4	TARGET CASE: TRANSPORTATION END-USE ENERGY DEMAND, 1985-2005 Nova Scotia Department of Mines and Energy	112
3-5	TARGET CASE: TOTAL END-USE ENERGY DEMAND, 1979-2005 Nova Scotia Department of Mines and Energy	113
3-6	TARGET CASE: PRIMARY ENERGY DEMAND Nova Scotia Department of Mines and Energy	115
3-7	TARGET CASE: NOVA SCOTIA PRIMARY ENERGY DEMAND - INDIGENOUS VS. FOREIGN SOURCES Nova Scotia Department of Mines and Energy	116
3-8	POTENTIAL ENERGY TECHNOLOGIES Nova Scotia Department of Mines and Energy	123
3-9	TARGET CASE: NOVA SCOTIA PRIMARY ENERGY SURPLUS (SHORTFALL) Nova Scotia Department of Mines and Energy	138
3-10	NOVA SCOTIA: PROXIMITY TO FOREIGN MARKETS	144

LIST OF BOXES

TITLE PAGE

1-1 New York Times News Service Report 8

1-2 Excerpts from the National Energy Program, 1980 and the National Energy Board Supply/Demand Report, 1984 20

1-3 The International Energy Agency 24

1-4 Energy Intensity and Fuel Conversion 25

1-5 Primary and End-Use Energy Demand 28

2-1 Coal Properties 48

2-2 Longwalls 50

2-3 New Coal Technologies: Carbogel and Beneficiation 53

2-4 Hydrocarbon Liquids Fractionation 55

2-5 Solar Heating 64

2-6 Fractional Distillation 68

2-7 Electrical Generating Capacity 69

3-1 Representative Energy Management Initiatives 120

3-2 Suggested Electrical Initiatives 127

3-3 Suggested Forest Biomass Initiatives 129

3-4 Suggested Offshore Gas and Oil Initiatives 131

3-5 Suggested Coal Initiatives 134

3-6 Suggested Peat Initiatives 135

3-7 Suggested Municipal Solid Waste Initiatives 135

3-8 Suggested Solar and Geothermal Initiatives 136

3-9 Suggested Crude Oil Supply Initiatives 140

ENERGY PLAN, 1985

SUMMARY

1.0 INTRODUCTION

In late 1979, the Nova Scotia Department of Mines and Energy published Energy: A Plan for Nova Scotia. The 1979 Energy Plan was the first comprehensive energy planning proposal by the government of Nova Scotia. It followed from the unexpected and economically devastating world oil price and supply shocks of 1973 and 1978-79 which demonstrated Nova Scotia's precarious dependence on foreign oil.

Both in purpose and in content, this document is an updated energy plan which both builds on the achievements of the 1979 document and takes into account significant changes in the energy environment since 1979. Its purpose is fourfold: (1) to review the thrusts of the 1979 Energy Plan in light of the dramatic changes that have since occurred in the energy sector; (2) to provide a status report on the conditions existing in 1985; (3) to suggest how the energy sector may develop in the next decade; and (4)to suggest broad policy options to minimize emerging difficulties and maximize the benefits from emerging opportunities.

When the 1979 Energy Plan was formulated, information which dealt with the provincial energy sector in a coordinated manner was scarce. The 1979 Energy Plan was successful, but it was prepared in extremely demanding circumstances. **Energy Plan, 1985** is put forth as an accessible source of information and as departmental policy recommendations to which interested individuals and groups can respond. This approach should contribute to an informed discussion of the issues, during which all points of view can be canvassed and represented prior to the submission of firm policy proposals to the Executive Council.

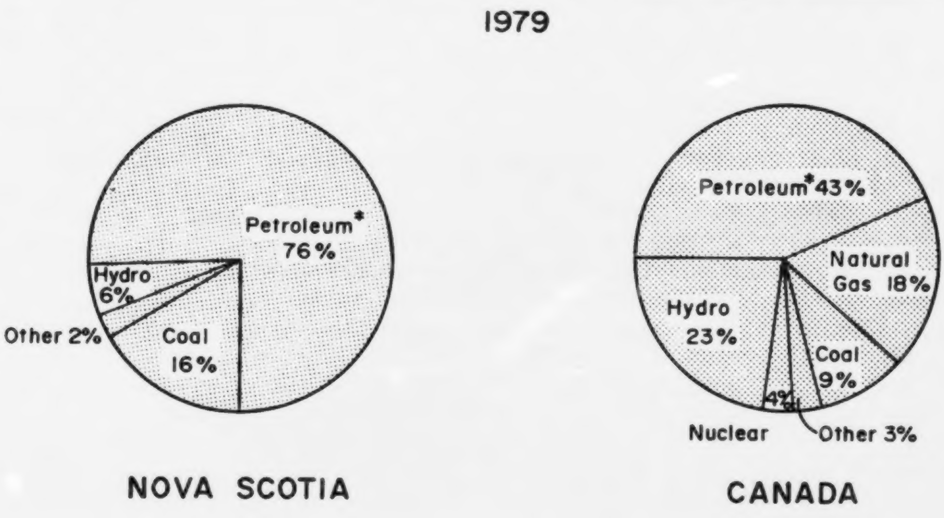
Energy Plan, 1985 is divided into three Parts. Part One reviews the international, national and provincial environments within which the planning process must operate. Part Two describes Nova Scotia's energy resources, the provincial energy model and the "status quo" case (i.e. the energy outlook if no new initiatives take place). Part Three analyzes ways in which the "status quo" scenario could be improved, describes the "target" or optimum case and suggests options to achieve this scenario.

2.0 PROGRESS TO DATE

When the 1979 Plan was prepared, the most startling aspect of Nova Scotia's energy supply/demand picture was its extreme reliance on oil, all of which was imported. As shown in Figure S-1, 76 percent of Nova Scotia's primary energy was supplied by petroleum (including natural gas liquids) versus 43 percent for Canada as a whole.

There were several reasons for this disproportionate dependence. Unlike most provinces, Nova Scotia had no large-scale river hydro resources, no access to natural gas and no access to domestic oil due to its limited supply and transportation difficulties. In addition, Nova Scotia's significant coal and tidal resources had not been developed due to the availability of inexpensive and seemingly secure supplies of imported oil during the fifties and sixties.

FIGURE S-I PRIMARY ENERGY DEMAND



*Note: Petroleum includes natural gas liquids.
Source: Department of Energy Mines and Resources

The problems resulting from this dependence on imported oil were energy costs higher than the national average and insecurity of oil supply. To reduce these problems, the 1979 Energy Plan listed six objectives:

1. Mount a major effort in conservation in every sector of the economy: residential, commercial, industrial and transportation.
2. Substitute for oil in every feasible way.
3. Bring on indigenous energy supplies: oil and gas, coal river and tidal hydro, biomass (including wood), wind and solar.
4. Ensure against major disruptions in energy supplies.
5. Develop Nova Scotia's own technical and business expertise to the maximum possible extent.
6. Provide for close cooperation among neighbouring provinces and the nation generally in energy supply and distribution.

A seventh objective which was implicit in the very publication of the 1979 Energy Plan was raising the awareness of the public, institutions and even government to the importance of energy issues and planning. Nova Scotia has successfully implemented the majority of the 1979 Energy Plan recommendations with positive effects on the provincial energy mix and on the provincial economy.

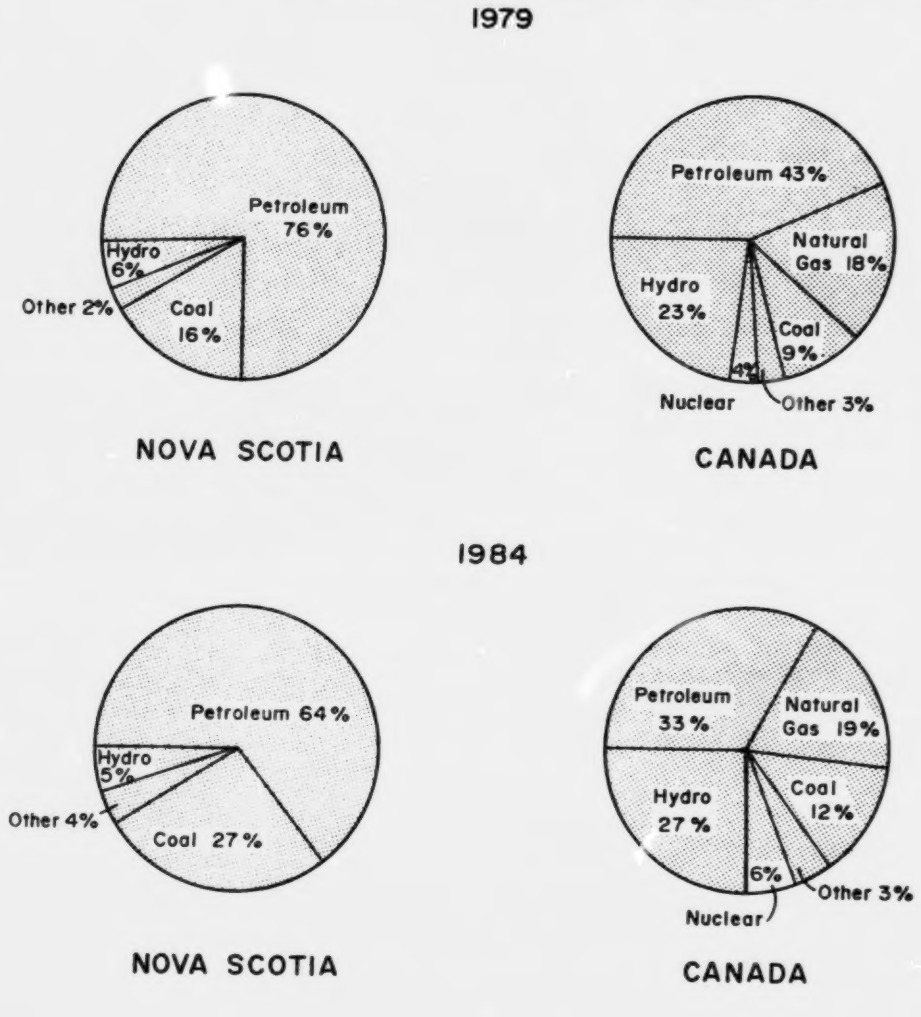
Conserving Energy

From 1979 to 1983, energy consumption in Nova Scotia declined substantially. Although it is difficult to distinguish the exact impact of conservation initiatives from the effects of energy pricing and economic trends, the fact that the province experienced significant reductions in energy use during a period of overall economic growth argues strongly that implementing the 1979 recommendations had a measurable effect. In 1984, Nova Scotia experienced its first small increase in primary energy use, but this was more than accounted for by economic growth.

Substituting for Oil

By 1984, Nova Scotia was in a better position with respect to both dependence on oil and, therefore, security of supply, although its situation was still worse than the national average as shown in Figure S-2.

FIGURE S-2: PRIMARY ENERGY CONSUMPTION BY FUEL NOVA SCOTIA AND CANADA, 1979 AND 1984



Note: Petroleum includes natural gas liquids
Source: Energy Information Handbook; EMR

Oil represented less than 64 percent of total primary energy consumption, with approximately one-third of that oil being supplied by Canadian producers. Coal accounted for 27 percent of Nova Scotia's primary needs, up over 50 percent from 1979. In addition, considerable progress had been made toward the development of indigenous energy resources such as offshore natural gas, forest biomass and tidal power.

Developing Indigenous Supplies

This improved energy supply situation resulted from initiatives by the private sector, government and crown corporations. The Nova Scotia Power Corporation built four 150 megawatt coal-fired generating plants which dramatically reduced its dependence on heavy fuel oil. The Cape Breton Development Corporation completed an expansion at the Lingan Mine and continued development of the Prince Mine. Oil companies, encouraged by the 1982 Canada-Nova Scotia Offshore Agreement, increased offshore exploration and development activity. The Tidal Power Corporation completed the Annapolis project in 1984 and conducted feasibility studies of large-scale tidal projects in 1981-82 and 1984-85, confirming the viability of a full-scale tidal project. Major studies were carried out on the feasibility of wood chip substitution, confirming that this is a major potential energy resource. Nova Scotia's peat reserves were evaluated with promising results and several studies were completed on the utilization of municipal and agricultural wastes. Assistance was given to about 300 renewable energy and innovative energy conservation projects between 1980 and 1983, encouraging research into their practical application to Nova Scotian conditions.

Developing Provincial Expertise

There have been three main aspects to the development of provincial expertise. The first was the enhancement of research and development programs, both in the private sector and in government, so as to ensure that Nova Scotia remains abreast of relevant new energy technologies. The second was the development of training programs to ensure that Nova Scotians can fill energy-related jobs as they become available, especially with respect to offshore gas production and coal mining. The third was the negotiation of administrative and legislative agreements with the federal government to ensure that Nova Scotian business benefits as much as possible from energy-related projects, both through economic participation and technology transfer.

Ensuring Secure Supplies

The substitution of indigenous energy resources for imported oil was, of course, one way in which the 1979 Energy Plan proposed to achieve a security of supply. However, a very large concern continued to exist: in the event of an international crisis, Atlantic Canada would lose its access to imported oil. Although the federal government has done considerable work on detailed plans for allocation of Canada's oil in the event of an emergency, the province remains concerned that these plans are not sufficient to guarantee that the impact of any oil shortage would be distributed equally throughout the regions of the country.

Providing for Energy Cooperation

The 1979 Energy Plan recommended "an all-out effort to establish a regional power pool...", and called for Nova Scotia to take the lead in developing a regional plan that would enable the province to obtain a substantial amount of power from a Maritime Power Pool.

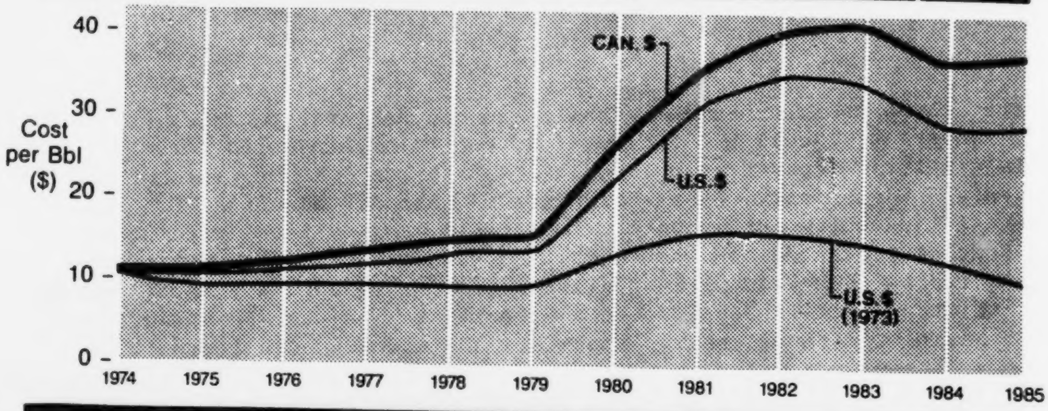
Despite the best efforts of all involved, consensus could not be reached and the Maritime Energy Corporation was set aside in 1980. However, a Coordinating Committee of Maritime Electric Utilities (CCMEU) was formed to facilitate regional cooperation. Significant cost savings to the Maritime region, estimated at $27 million in 1983, are being made through coordination of power sales.

3.0 CURRENT SITUATION

The energy situation facing Nova Scotia today is much different than that in 1979. While our dependence on oil remains higher than the national average (64 percent versus 33 percent), the problems associated with that dependence appear less ominous in the short-term.

International energy dynamics have changed dramatically, with the fear now being an uncontrolled drop in oil prices rather than continuing price increases (see Figure S-3). An oversupply of oil exists and OPEC's share of the market has dropped considerably. Together with falling prices, this causes concerns about security of supply to recede into the background of energy planning. However, the international energy environment is still unstable and potentially volatile, with relatively little attention being paid to the implications of a renewed dependence on OPEC (and particularly Middle East) reserves in the 1990's (see Figure S-4).

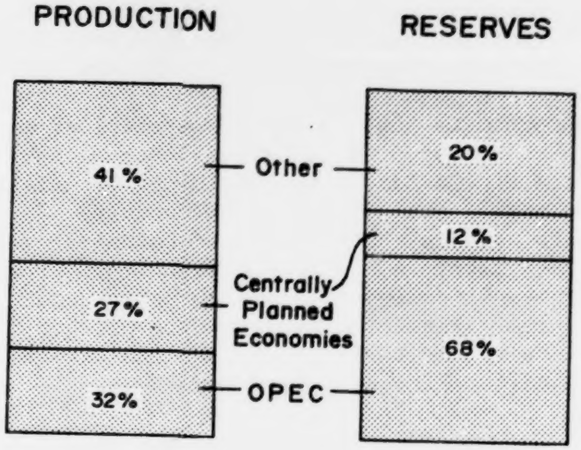
FIGURE S-3 PRICES FOR ARABIAN LIGHT OIL, 1974-1985



Source: BP Statistical Review of World Energy, June 1985, pp. 13.

Federal energy policy is moving from direct involvement to a market-oriented approach, with the focus on short-term economics rather than long-term stability. Market viability has become the basic criterion for the evaluation of options, with a reduced emphasis on programs to promote conservation, oil substitution and the development of indigenous energy resources. This approach may hold dangers for Nova Scotia since, until regional sources of gas and oil become available, we in Atlantic Canada remain more vulnerable than the rest of Canada to the vagaries of international oil politics and pricing.

FIGURE S-4
WORLD OIL PRODUCTION AND RESERVES, 1984



Source: BP Statistical Review of World Energy, June 1985, pps. 2,5.

Despite changing international conditions and national policies, the basic thrusts of the 1979 Energy Plan appear to remain valid for Nova Scotia in 1985: conservation; oil substitution; the development of indigenous resources; the maximization of economic benefits to the province; security of supply; and close cooperation with both neighbouring provinces and the federal government to ensure efficient and equitable energy supply and distribution. Regardless of national policies, these remain Nova Scotia's priorities. They can be summed up as two basic objectives: **energy stability** and **economic development.**

Energy stability is critical to both government and private sector planning. In Nova Scotia, it can best be achieved by continuing to diversify the province's energy mix to bring our petroleum dependence more in line with the national average. Energy stability can also be assisted by continuity in energy planning. Although the 1979 Energy Plan was influenced by the then existing international conditions, it was largely based on Nova Scotia's historical energy position and long-term forecasts respecting oil pricing and supply. Neither have substantially changed. There is no reason for the province to "change horses in mid-stream"; on the contrary, there is a considerable danger inherent in such a course. Energy resources are rarely developed quickly and are developed optimally only in an environment of long-term policy stability. There is a strong possibility that the conditions existing in 1979 and 1980 could re-emerge in a half-dozen years, a very short time in the world of energy resource development.

Diversity requires the development of the full energy mosaic, including both alternative energy resources and conservation. Traditional "supply *expansion" megaprojects must be complemented* by promotion of "demand reduction" initiatives. Efforts must be made to improve the workings of the energy marketplace by enhancing competition between resources and between suppliers of those resources.

Economic development is closely linked, both directly and indirectly, with these initiatives through subsitution of indigenous resources for imported oil and encouragement of conservation. The 1979 Energy Plan clearly recognized the potential of energy resource development as an engine for economic development. Between 1979 and 1985, Nova Scotia, with major programs in both coal development and offshore gas exploration, was probably more successful than any other part of Canada in achieving this economic potential.

Energy efficiency projects also have had considerable economic spin-offs. Studies indicate that the job-creation ratio of energy conservation is almost twice that of energy supply. Nova Scotia's conservation programs have resulted in the emergence of a number of small businesses specializing in alternative energy technology, while retrofit and information programs appear to have created a small boom in the renovation industry. The fact that conservation programs lead to the development of small businesses is entirely consistent with the province's economic development policies.

The magnitude of our energy resources (i.e. coal, offshore gas, tidal power) relative to provincial energy demand, combined with Nova Scotia's strategic location with respect to major markets for these resources creates the prospect of significant export opportunities. The United States Northeast, only several hundred miles away, faces energy problems similar to ours and has expressed strong interest in natural gas and electricity from Nova Scotia. Being on tidewater, the world market for coal and for energy-based products such as petrochemicals is at our doorstep. Processing and export potential must be realized and enhanced if our indigenous energy resources are to generate long-term economic growth and stability.

Economic development will also result in an indirect impact on energy development. A diverse, secure energy supply mix within the province will be a strong attraction to foreign investors seeking stability in an increasingly troubled world. As our provincial and regional energy resources are developed and our other manufacturing attributes are recognized (for example, skilled labour, transportation links), Nova Scotia will be in an excellent position to attract new industry.

Nova Scotia has had an enviable degree of success in the implementation of its 1979 Energy Plan. There are sound reasons to maintain its thrusts through a consistent energy policy, one emphasizing the development of indigenous resources and increased energy efficiency, but one appropriately modified to meet the difficulties and challenges presented by the mid-1980's.

4.0 THE PROVINCE'S ENERGY RESOURCES

Provincial influence over energy policy arises mainly in the areas of energy mix and the interaction between energy consumption/production and overall economic growth. This requires a thorough knowledge of indigenous energy resources and the potential for increasing energy efficiency. Essentially, energy planning assesses energy resources and demand, analyzes the implications of the relationship between the two and recommends ways to achieve improvements by modifying either demand requirements or supply possibilities.

The province's indigenous energy resources include those presently used (coal, river hydro, tidal power, wood), those of potential significance (offshore oil and gas, peat, municipal wastes) and those which are currently seen as experimental or marginal (onshore petroleum and oil shales, solar, wind, agricultural waste). Non-indigenous sources (e.g. imported oil), end-use energy forms such as refined petroleum products and electricity must also be examined before analyzing policy options. The potential for improvements in energy efficiency must be determined before demand projections can be made. A unit of energy saved is a unit of energy which does not have to be produced or imported.

Coal

With recoverable reserves of one billion tons, coal remains the largest indigenous energy resource in Nova Scotia. With annual production of approximately 3 million tons of raw coal, there are ample reserves to support increased production for domestic and export markets. Currently, most coal produced in the province is used by the Nova Scotia Power Corporation to generate electricity. Nonetheless, coal exports peaked at over one million tons in 1983 and, although reduced in 1984, are expected to increase.

The future market for Nova Scotia coal will be influenced by its competitiveness with respect to price and quality in the international market and the influence on demand of new technologies such as circulating fluidized bed combustion and coal-liquid mixtures.

Offshore Gas and Oil

Sixteen significant gas discoveries and three significant oil discoveries have been made on the Scotian Shelf to date. Total discovered reserves are approximately 4.3 trillion cubic feet of natural gas and 105 million barrels of oil and condensate. It is now evident that the Scotian Shelf is a "gas-prone" rather than an "oil-prone" area. However, the strong possibility remains for modest oil finds.

Considerable progress has been made by Mobil Oil Corporation and its partners with respect to development of the Venture Gas Project. Milestones include approval of environmental and socio-economic assessments, an initial development plan, gas sales agreements and an export application filed with National Energy Board.

Tidal and River Hydro

Studies in 1977 and 1982 have endorsed the technical and economic feasibility of tidal power. The Annapolis Project, a 20 MW pilot plant completed in 1984, is now part of the provincial generating system. The Tidal Power Corporation is continuing its efforts to develop a major tidal project in the Bay of Fundy.

In 1984, river hydro accounted for five percent of primary energy demand in Nova Scotia. The major constraint to increased hydro generation in Nova Scotia is quite simply the lack of suitable sites. Three have been developed by the Nova Scotia Power Corporation since 1979.

Forest Biomass

Forest biomass supplied 4.8 percent of the province's total primary energy demand in 1984. Since the annual supply of both softwood and hardwood is limited, forest residue will have to play an increasing role if wood is to maintain its role as an energy resource. Forest residue available for energy purposes is extremely difficult to assess, but is presently estimated at over one million bone-dry tons per year which is equivalent to three million barrels of oil per year.

Additional biomass resources available on a "one-shot" basis include areas with budworm-diseased softwoods and unmerchantable species such as alder. Once harvested for energy, this land would be reforested with commercial species. Current estimates of the economically recoverable biomass from these sources is 18.7 million bone-dry tons.

Peat

Most of the fuel peat identified to date is in southwestern Nova Scotia. Exploitable reserves are estimated at 14 million tons (or the equivalent of over two million barrels of oil). The peat resources in the rest of the province are, on the whole, best suited for horticultural uses.

Municipal Solid Waste (MSW)

As the cost of developing new landfill sites continues to rise and environmental concerns grow, refuse-fired energy plants (RFEPs) are becoming an increasingly common and economical solution to public waste disposal in large urban areas in the United States and Canada. As existing landfill sites in Nova Scotia near the end of their useful lives, municipal governments should seriously consider RFEPs.

Onshore Petroleum and Natural Gas

In the last four years, there has been a renewed interest in exploration for oil onshore Nova Scotia. While less prospective than the offshore, a discovery on land would be quite beneficial.

Renewable Energy Sources

The remaining energy sources available to Nova Scotians are solar, wind and agricultural wastes. Based upon the demonstration projects which have taken place over the last five years, it appears that for the foreseeable future, these energy sources can best be utilized for small-scale projects in appropriate situations. They are not likely to have a measurable impact on overall provincial energy supply in the immediate future.

Imported Oil

Oil, both crude and refined petroleum products, continues to be a necessary import in sectors such as transportation where substitution potential is limited. Because of the drop in demand over the last few years, both in the region and in export markets, Atlantic Canadian refineries have a substantial overcapacity at the moment.

As oil demand dropped, the composition of the market for refined petroleum products also altered significantly. Refineries have adjusted their product mix accordingly. Through rationalization and upgrading, the refineries now have more flexibility with respect to the varieties of crude oil that can be used and more sophistication in blending to achieve the desired mix. Decontrol should allow the refineries considerably more choice in the mix of crudes obtainable, allowing them to better respond to the market. On the other hand, it could add to the existing overcapacity if imported refined petroleum products cut into sales of provincially refined products.

Although international oil prices have stabilized recently and a supply surplus exists, the danger always remains that international events, or the re-emergence of OPEC as a strong cartel, could cause a supply crisis. In that case, domestic supply could be severely limited because of transportation constraints and prior market commitments. If the development of oil finds off Newfoundland proceeds as currently planned, the supply of oil to Atlantic Canada will be much more secure. In addition, the use of condensate (produced in association with offshore natural gas) would significantly reduce the province's dependence on imported oil.

Electricity

Because of its versatility and convenience, electricity is the most popular end-use energy source other than refined petroleum products. Since electrical generation is under provincial jurisdiction and involves a variety of primary fuels, including indigenous coal, it becomes a critical component of provincial energy planning. The Nova Scotia Power Corporation provides almost 95 percent of the generation and 99 percent of the transmission of electric power in the province.

Given rising oil prices and concerns about security of supply, the 1979 Energy Plan strongly recommended that the electrical system revert to coal for its primary energy input as rapidly as possible. The transitions were completed ahead of schedule and under budget. By 1984, coal accounted for over 70 percent of the electricity generated in the province, with oil and hydro accounting for approximately 15 percent each.

Energy Efficiency

Increased energy efficiency provides an alternative to increased energy production in achieving the optimum relationship between supply and demand, or energy stability. Improved energy efficiency not only reduces ongoing energy supply costs, but also prolongs the availability of indigenous energy reserves.

The residential sector accounts for approximately 25 percent of total provincial end-use energy consumption. Energy demand in the sector dropped by 12 percent between 1979 and 1984, while the market share of refined petroleum products dropped from 74 percent to 60 percent. The residential sector in Nova Scotia has exhibited some of the strongest improvements both in energy efficiency and switching from refined petroleum products. Considerable potential remains with realistic savings estimated at almost 30 percent in existing units.

The industrial sector accounts for 26 percent of total provincial end-use energy consumption. Industrial sector end-use energy demand dropped by 35 percent between 1979 and 1984, with dependence on refined petroleum products rising slightly from 34 percent to 39 percent. Energy efficiency has improved by approximately 50 percent, but could still increase by another 16 percent.

The commercial sector's growing use of energy meant that its percentage share of total provincial end-use energy consumption rose from 12 percent in 1979 to 17 percent in 1984. End-use energy demand in this sector rose by about 20 percent between 1979 and 1984, while dependence on refined petroleum products stayed about the same, around 75 percent. It is estimated that improved energy efficiency techniques could reduce this sector's consumption as much as 20 percent.

The percentage of total provincial end-use energy demand accounted for by transportation remained constant at 34 percent. Energy consumption dropped by 15 percent between 1979 and 1984, while energy intensity per vehicle dropped slightly. All sectoral demand is provided by refined petroleum products. Present estimates are that feasible conservation programs for road transport could reduce consumption by 10 percent.

Aided by government-sponsored conservation programs and rapidly increasing energy prices in the past decade, consumers have adjusted to more efficient consumption patterns. New conservation savings can still be generated, but this will require more imaginative approaches by users to overcome complacency resulting from stable energy prices.

5.0 FORECASTS

In light of the changing international oil price and supply outlook, the government of Nova Scotia must re-examine its energy policies. Should it maintain its 1979 initiatives and continue to reduce the province's dependence on foreign oil? If so, how should this be accomplished in light of the new federal emphasis on market-oriented policies and provincial budgetary restraints?

To assist in developing answers for these questions, two energy demand/supply forecasts to the year 2005 were prepared for the province - the "status quo" case and the "target" case.

"Status Quo" Case

The status quo case is designed to estimate provincial trends which would result if the provincial government took no further action on energy issues. Energy supply and demand within the province are assumed to respond to national and international economic conditions which may not always be optimal for Nova Scotia. More specifically, the status quo case assumes that we do not:

* take any initiative to stimulate development of indigenous energy resources;

* encourage the use of new fuel production and utilization technologies; or

* promote or advise on energy efficiency opportunities

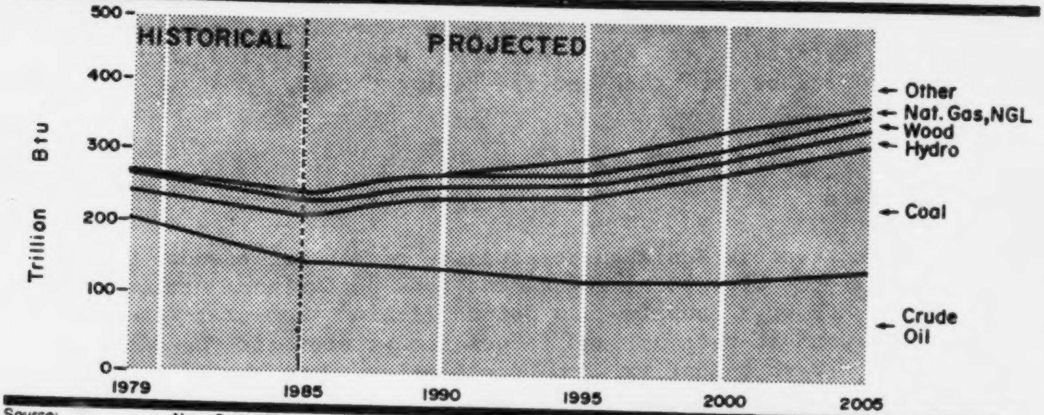
End-Use Energy

Total end-use energy demand is expected to increase at an annual growth rate of 1.5 percent. Electricity enjoys the largest increase in market share, rising from 14.1 percent to 23.1 percent of total demand. Refined petroleum products drop from 71 percent to 64 percent of total demand.

Primary Energy

Primary energy demand is projected to increase by 60 percent by the year 2005. Dependence on crude oil is forecast to drop significantly to about 40 percent in 2005, as reflected in Figure S-5. The largest increase in primary demand occurs with coal which is forecast to more than double, with a corresponding increase in its contribution from 27 percent to 46 percent. The major reason behind this increase is the use of coal-fired thermal generation for all incremental base-load electricity production. Demand for wood increases by 60 percent, although its contribution to the mix share stays about the same. Natural gas and gas liquids (including pentanes plus) account for one and three percent respectively of primary energy requirements by 2005. This penetration reflects the supply available for use within the province. Municipal solid waste, wind and solar account for less than 0.2 percent of primary energy demand in 2005.

FIGURE S-5 STATUS QUO CASE: TOTAL PRIMARY ENERGY DEMAND, 1979-2005



Source: Nova Scotia Department of Mines and Energy

Analysis

An analysis of the status quo forecast identifies some major problems.

Despite dramatic reductions in the share of the energy mix accounted for by oil, the province would remain highly dependent on this particular energy source. Equally important, the forecast indicates a potential supply/demand imbalance in coal which can be overcome by taking steps to ensure the development of new coal mines.

These projections also indicate that the supply of gas for domestic use is insufficient to meet potential demand in Nova Scotia. The discovery and development of additional gas supplies must be encouraged if this resource is to significantly enhance Nova Scotia's overall energy supply. Other resources would also be less than fully utilized under the status quo case; wood and peat are notable in this regard.

Finally, the potential of improved energy management is not fully exploited. Significant opportunities remain to further increase energy efficiency in all sectors of the Nova Scotia economy.

The net result of these projections is that, in the absence of ameliorative measures, the province might be dependent on outside energy sources for approximately 55 percent of its energy supply (i.e. primarily oil and a portion of its coal) and would not have surplus coal available for export.

The province's two paramount goals in energy policy are to ensure stability in energy markets and to use energy development to encourage economic development. The results of the status quo case indicate that a completely passive stance leads to a number of shortfalls in achieving these goals.

"Target" Case

The target case is designed to estimate provincial trends resulting from the use of effective planning and energy policy initiatives. These include measures to encourage the substitution of indigenous resources for fuels now derived from sources outside of Nova Scotia, the increased production of indigenous fuels and the implementation of cost-effective energy management measures to reduce the overall level of energy required.

The initiatives presented in the target scenario result in a significant increase in the production and utilization of indigenous resources. An additional offshore natural gas development, incremental to the Venture Gas Project, is forecast to begin production in the mid-1990's. As a result, the domestic natural gas distribution area is significantly enlarged. A new coal mine is brought into production so as to ensure sufficient Nova Scotia coal is available to both domestic and international markets. Other indigenous resources such as biomass, peat, municipal solid waste and coal gas are both produced and consumed in larger quantities.

End-Use Energy

The economic activity associated with expanding the production and consumption of indigenous resources has a ripple effect on the anticipated performance of the Nova Scotia economy. As the economy expands in response to the energy-related developments, so does the province's appetite for energy. As a result, the target scenario results in a net increase in end-use energy demand over and above the status quo case, although the incremental conservation efforts result in significant improvements to the efficiency with which we consume energy.

Electricity is expected to show the largest increase in consumption, but to a lesser degree than in the status quo case. The slower rate of increase is attributable to increased penetration of natural gas into space and water heating markets.

The demand for natural gas and gas liquids is forecast to increase above the status quo case, since increased supply from the offshore permits eventual expansion of the gas service area, as well as attractive pricing for liquids.

End-use consumption of coal also increases in the target case due to the introduction of technologies such as coal-liquid mixtures to overcome handling and storage problems, and fluidized bed combustion to reduce gaseous emissions.

Increased consumption of biomass results from the acceptance of wood chips as a technically and financially feasible fuel in Nova Scotia.

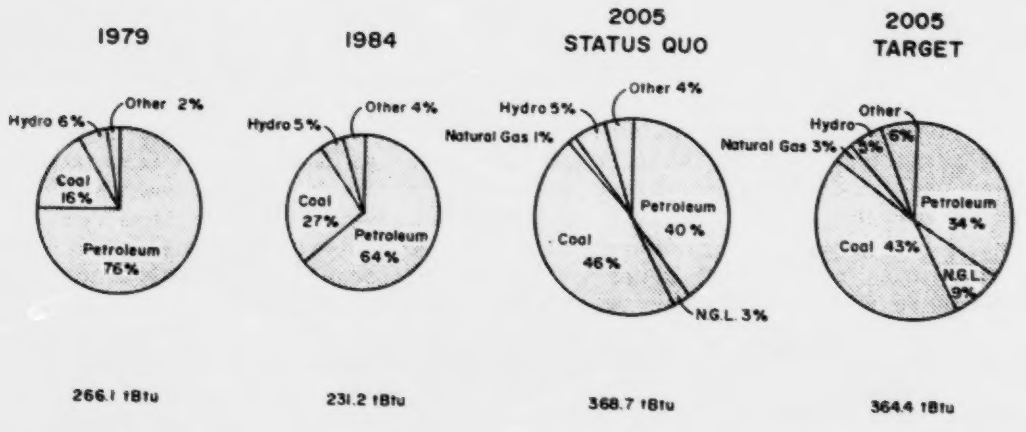
Peat and municipal solid waste begin to contribute to industrial end-use demand in the target case. Both are expected to be used in large facilities located in close proximity to the fuel source.

Primary Energy

The introduction of new and incremental fuel sources such as natural gas, biomass, municipal solid waste and peat results in a slower rate of growth in demand for electricity. Because electric generation is predominantly from coal-fired thermal generation, the slower growth in electricity demand translates into a slightly lower demand for coal for electric generation. However, coal production is considerably higher as mining capacity has been increased to serve local and export markets.

The primary energy mix under the target case is similar to that under the status quo, as shown in Figure S-6. However, use of indigenous energy resources is much greater under the target case (see Figure S-7).

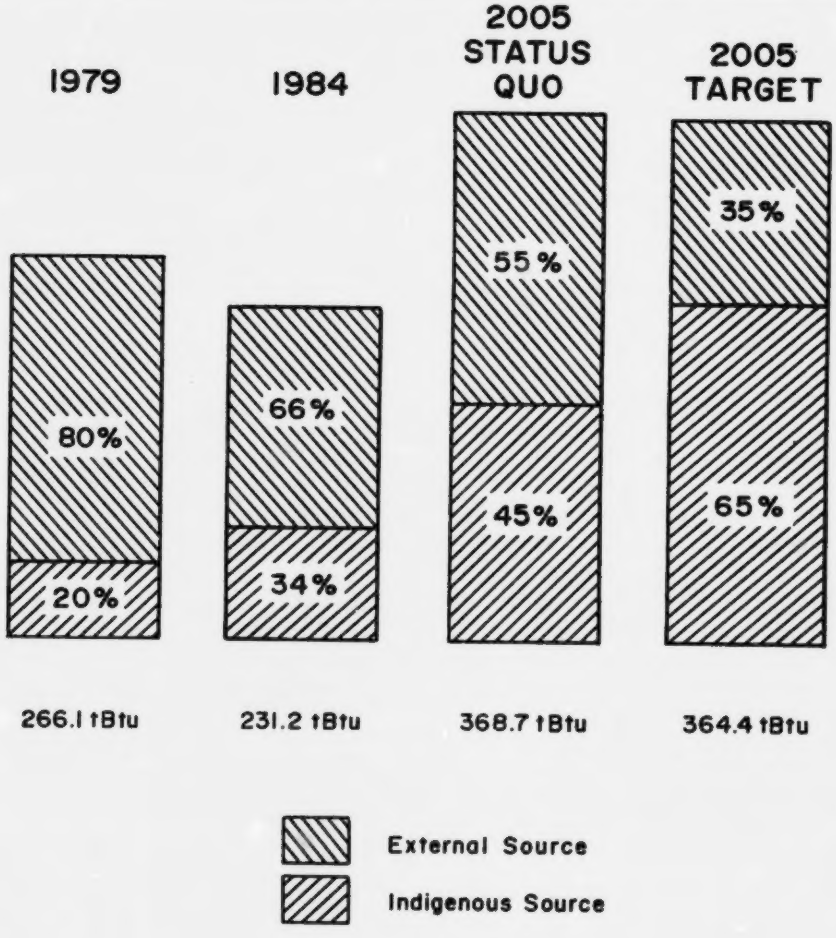
FIGURE S-6 TARGET CASE: PRIMARY ENERGY DEMAND



Note : Other includes biomass, solar, wind, peat, municipal solid waste
Natural gas liquids (N.G.L.) includes pentanes plus.
tBtu – trillions of Btu
Source: Nova Scotia Department of Mines and Energy

By 2005, this represents a reduction in external supplies from 55 percent in the status quo case to 35 percent in the target case. Production and consumption of indigenous primary fuel sources, including natural gas, natural gas liquids, peat, coal, crude oil, biomass, solar and wind energy, are increased under the target case.

FIGURE S-7
NOVA SCOTIA PRIMARY ENERGY DEMAND
Indigenous Versus Foreign Sources



tBtu – trillions of Btu

Source: Nova Scotia Department of Mines and Energy

Analysis

In the target case, energy supply and demand in the province are once again brought into balance, although at a different level than that of the status quo case. The more optimistic economic scenario engendered in the target case tends to drive energy demand up, although this is partially offset by more extensive energy management measures.

Energy stability is improved as Nova Scotians endeavour to lessen their dependence on external fuel supplies through the development of their own resources. This increased import substitution has two benefits - a reduced risk of energy supply curtailment due to international events and an increased percentage of fuel expenditures remaining within the provincial economy. This translates into **economic development.**

Over 2600 people are at present directly employed in coal mining activities, with a further 2000 employed in support roles. With coal production in the target case almost 60 percent greater than in the status quo case, and twice current levels, it can be anticipated that direct employment will increase substantially. Our coal resources create an opportunity for Nova Scotia to achieve a position at the leading edge in technologies related to mining, benefication, coal-liquid mixtures, demethanation and coal liquefaction.

Offshore activity has had a major impact on the Nova Scotia economy in the past several years and will continue to do so in the foreseeable future. The anticipated incremental increase in gross provincial product is due, in large part, to the activity associated with the incremental offshore activity. This will result as our offshore expands from the immediate Sable Island area to other regions of the Scotian Shelf.

Our other indigenous energy resources also make employment and income contributions to the provincial economy. While not as large in absolute terms as offshore gas and coal, on a per dollar output basis they can be expected to generate significant impacts due to their labour-intensive nature. Forest biomass, for example, offers significant rural and regional economic development opportunities. If even 10 percent of the resource base is utilized, 220 jobs per year are created in harvesting alone. Given the wide range of activities involved in using biomass as an energy source, employment impact is diffused throughout the economy creating a wide variety of small-scale business opportunities.

6.0 POLICY OPTIONS

Our policy options can be best characterized as the instruments available to produce the target case. Policies must employ the most appropriate and cost-effective methods of influencing the way certain targeted resources and technologies are utilized. In this way, energy markets can be focussed in a direction which is deemed to be consistent with our long-term goals. Implicit in the identification of such measures is a thorough knowledge of the energy resources available to the province, the technologies for using those resources and the factors which influence private sector decisions to supply and employ these resources and technologies.

The selection criteria employed to assess these policy choices were:

* Technical feasibility
* Cost-effectiveness
* Degree of government intervention in the market
* Potential to induce economic development
* Consistency with past policy
* Environmental considerations

Energy Management

Perhaps the most obvious conclusion from applying the criteria is the benefit of increasing the efficiency with which we consume energy. Using less imported energy lowers costs to Nova Scotians, while using less indigenous energy conserves valuable resources for future use. Moreover, the initiatives required to achieve improved energy management are often relatively low-cost information programs and require only a minimum of intervention in the market.

New Production and Consumption Technologies

In addition to existing production and consumption technologies, a wide spectrum of new technologies is available to the province. Not all, however, are suitable for use within the province. The new technologies which are incorporated into the target case are listed briefly below. These technologies will be utilized in the province if initiatives are taken to eliminate short-term barriers to their employment.

Coal Technologies

- * Coal Liquefaction
- * Fluidized Bed Combustion
- * Coal-Liquid Mixtures

Natural Gas Technologies

- * Natural Gas from Coal Seams (Demethanation)
- * CNG or Natural Gas for Vehicles (NGV)

Electric Technologies

- * Large-Scale Heat Pumps
- * Electric Duct or Plenum Heaters

Fuel Selection

As with energy efficiency and new technologies, the fuel choices and accompanying recommended initiatives in this section are the result of applying selection criteria to the range of possibilities. The indigenous fuel selections are presented in order of anticipated contribution to end-use energy demand and are followed by a discussion of imported fuels.

Electricity

The utilization of electricity produced using indigenous fuels rather than imported oil is an end-use energy source entirely compatible with provincial energy policy goals.

The Nova Scotia Power Corporation, the Nova Scotia and Federal Departments of Environment and the Cape Breton Development Corporation have been working to develop and implement programs to minimize and mitigate against any adverse environmental effects associated with an expanded use of coal for electrical generation. These programs include the expansion of coal cleaning facilities and research into circulating fluidized bed technology.

Indigenous Natural Gas, Gas Liquids and Crude Oil Products

The opportunities to substitute indigenous gas or oil for imported petroleum products are numerous. The technology required to produce and consume natural gas, liquids and oil are well proven and readily available.

To achieve the optimum use of indigenous natural gas and liquids will require a substantial effort directed toward public awareness and acceptance of these fuels. Because of traditional consumer resistance to new fuels, programs may be required to provide technical advice and information to those wishing to convert from more traditional energy sources. Efforts may also be needed to ensure sufficient trained personnel are available to perform conversions to gas or liquid fuels. Finally, steps may have to be taken to ensure that the high cost of gas distribution infrastructure and resulting tariffs do not preclude the use of gas in the province. The federal government will be relied upon to provide funding assistance similar to that provided to Quebec under the National Energy Program.

On the exploration and production side, timely issuance of lands, an attractive fiscal regime and efficient regulatory review will be necessary to encourage sustained activity, particularly projects subsequent to the Venture Gas Project.

Forest Biomass

Forest biomass presents a number of opportunities to enhance the use of indigenous fuels in Nova Scotia. Wood supply from roundwood, forest residue and waste wood is currently surplus to present requirements. Efficient and economic technologies exist to both produce and consume wood.

Potential consumers, including government facilities, must be made more aware of the benefits of wood consumption and the associated economics. Individuals or companies in a position to produce wood for fuel must also be made more aware of available technologies (particularly wood chipping) and of the economic benefits of such production.

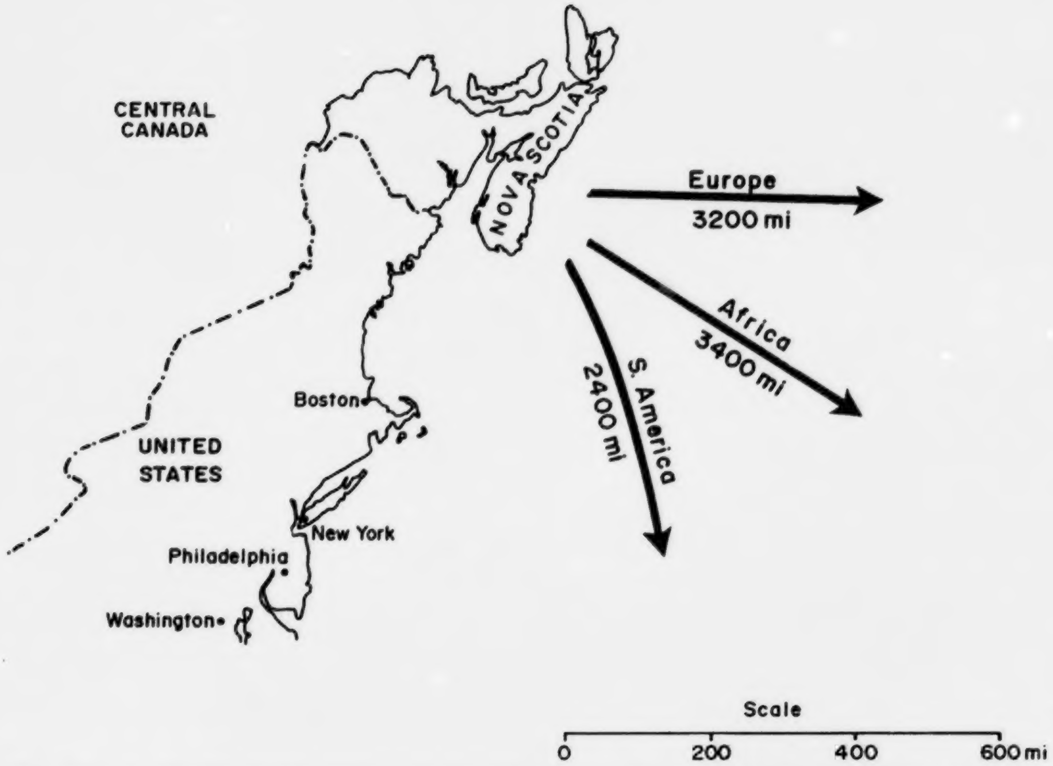
The environmental impacts of harvesting non-commercial species and of removing logging residues for energy purposes are expected to be negligible provided proper techniques are used. Detailed studies have determined that nutrient depletion of the soil will not be a problem, nor will there be any adverse effect on wildlife habitat. As in any forestry operation, greenbelts must be left near lakes and streams to avoid problems related to erosion and siltation.

Coal

Coal remains the province's most available and potentially adaptable indigenous energy resource. Coal plays a major role as a source of primary energy for the production of electricity. As an end-use fuel, however, coal plays a fairly minor role due mainly to handling problems and costs when used for small-scale (residential, commercial) space and water heating. Technologies such as fluidized bed combustion and coal-liquid fuels offer tremendous potential for stimulating increased consumption of coal.

Given our large coal reserves and proximity to international markets (see Figure S-8), export opportunities for Nova Scotia coal should be pursued. Exporting coal by wire (e.g. coal-fired electrical generation) to the United States can also expand markets for our coal. Coal-fired electricity and coal-liquid mixtures are good examples of the type of "value added" energy commodities we should seek to export.

FIGURE S-8
NOVA SCOTIA: PROXIMITY TO FOREIGN MARKETS


CENTRAL
CANADA
NOVA SCOTIA
Europe
3200 mi
Africa
3400 mi
S. America
2400 mi
Boston
UNITED
STATES
New York
Philadelphia
Washington
Scale
0
200
400
600 mi

On the production side, new initiatives must be taken to ensure that increases in demand are satisfied. Exploration and mine development must continue at a pace which ensures sufficient supply at the mine mouth. The use of coal washing and blending technologies should be encouraged in order to produce coal suitable to a wide range of end-uses. Technologies (e.g. gasification, liquefaction) which convert coal to other more convenient end-use forms will lead to increased demand for coal.

Other Fuels

Remaining indigenous end-use fuel expected to play a minor role in the target case are coke oven gas, peat, municipal solid waste, solar power and wind.

These fuels are not expected to account for more than one percent of the target case end-use demand in 2005 and do not offer the possibility for market development outside the province.

Residual Fuel Sources

Indigenous fuels could account for approximately 65 percent of primary energy in the target case by 2005. Nevertheless, a large portion of Nova Scotia's energy requirements must still come from outside the province. A minor amount of imported electricity will come from New Brunswick, but most imported energy will be in the form of crude oil or refined petroleum products produced elsewhere in Canada or the world.

As new sources of crude oil are developed in Canada, such as tarsands in Alberta and fields offshore Newfoundland, our dependence on less secure foreign sources of crude oil will diminish.

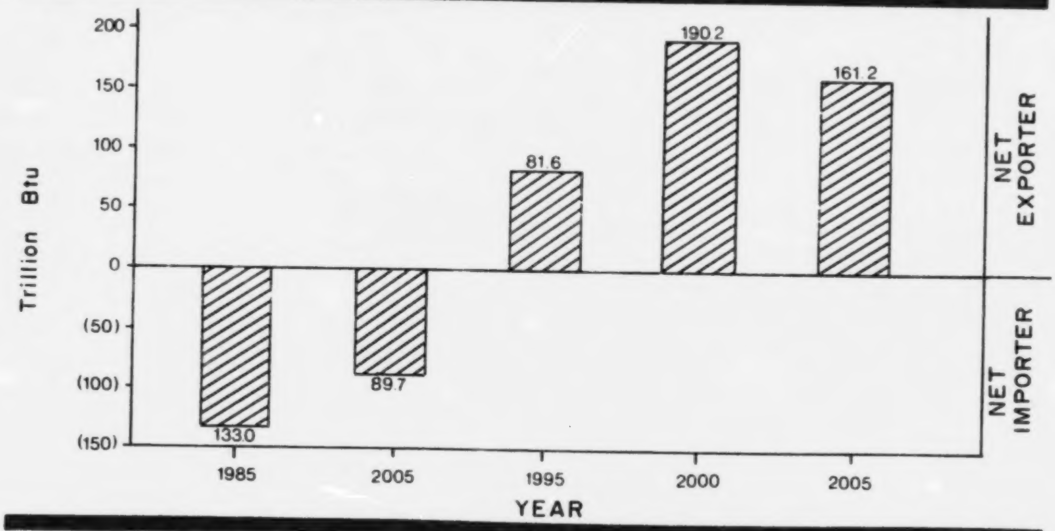
7.0 CONCLUSIONS

Recent falling oil prices and supply surpluses may lead some to become complacent about our energy future. However, international energy pricing and politics remain volatile and unpredictable. As non-OPEC oil production peaks and begins its inevitable descent, the strategic importance of Middle East oil reserves will resurface.

Given the time frame required for energy supply initiatives to be undertaken and to attain their desired results, energy planning by necessity looks to the middle- and long-term. Thus the rationale for this document and the forecast period addressed. During this time frame, it is expected that OPEC or a successor cartel will have regained substantial control over traditional crude oil supplies and oil prices will be on the rise.

This document advocates consistency with the general policy goals outlined in the 1979 Energy Plan. The essential themes upon which it was based have not changed. Energy demand and supply must be brought into balance. Secure supplies of energy at stable prices must be confirmed. Production and utilization of indigenous resources should be increased to meet demand in provincial and export markets. Nova Scotia has the resources to become a net exporter of energy (Figure S-9).

FIGURE S-9 TARGET CASE: NOVA SCOTIA PRIMARY ENERGY SURPLUS (SHORTFALL)[1]



1) Provincial primary energy production minus primary energy demand.
Source: Nova Scotia Department of Mines and Energy.

Some of our energy goals may be realized without government action. This was the basis for the status quo case. Market forces do, after all, function well in allocating resources among competing users.

However, markets are often less than "perfect" according to the classic economic definition. In selected instances, government has a role to play in the elimination or reduction of barriers to the increased production or optimum utilization of resources. This is particularly true for a commodity as strategic as energy.

This is the foundation upon which the target case is built. Government would take steps, in a limited way, to ensure that the public has a clear understanding of the situation and that the potential of our energy goals is maximized. The target case is a response to the uncertainties that surround energy producers and users.

One point must be emphasized. Efforts to reduce the use of oil because of security of supply problems must be measured against economic penalties of switching to another fuel. A point may be reached where using imported oil may be considered preferable to switching to a more secure but expensive fuel. Government's role is to ensure that sufficient information is available to permit a rational decision; that every effort is taken to ensure shortages do not occur; and that the negative effects of any shortages are minimized.

To achieve the target case forecast, a number of initiatives must be taken. Those recommended in this document are listed at the end of the Summary. While this plan of action is specific and comprehensive, it is flexible enough to accommodate the international upheavals which will inevitably occur to distort energy pricing or supply.

Those technologies and fuel sources with future potential but which have not been included in this Plan must be monitored and pursued. For example, as large-scale tidal power moves closer to the development stage, it can be included in a future forecasting effort. The same can be said for large-scale coal liquefaction, coal gasification, exports of coal-fired thermal electricity and large-scale efforts to smooth electricity supply peaks.

The provincial government will continue to develop, maintain and update energy data bases and energy forecasting models in order to permit ongoing estimates of energy supply and demand.

Energy Plan, 1985 outlines the options open to the province. It is meant to contribute to an informed dialogue about the energy problems and opportunities that confront us, the options by which we can influence our energy future and the courses best suited to realizing our energy goals. Input from those sectors of the Nova Scotia public which have an interest in and concern for energy planning is the next step in this policy formulation process.

RECOMMENDED INITIATIVES

REPRESENTATIVE ENERGY MANAGEMENT INITIATIVES

General

Review past and existing programs to determine their appropriateness and to ensure the cost-effectiveness of new programs.

Ensure that provincial government programs related to energy are coordinated between departments and with those offered by the federal government.

Promote energy management techniques through publications, audio-visual presentations, seminars and workshops in cooperation with the federal government.

Include energy efficiency standards within any future provincial building code.

Provide industry, business and the general public with access to energy related information through the ongoing support of an energy information centre.

Residential

Organize and promote province-wide workshops on such topics as condensation prevention, retrofit problems, airsealing, etc.

Produce and promote an Energy Efficiency Guide for Renovators.

Utilize existing programs (such as the Summer Works Program) to provide weatherization assistance to needy groups.

Review trade school and training institution courses, and improve the energy management component; investigate the feasibility of refresher courses on energy management.

Organize a pilot project providing a testing program for complete heating systems.

Cost-share the purchase of combustion efficiency testing equipment to ensure its availability throughout the province

Promote combustion efficiency testing for fossil fuel heating systems, to be provided by existing burner companies.

Provide energy audit programs for homeowners.

Introduce an energy rating system for new homes in cooperation with the building industry.

Industrial/Commercial/Institutional

Develop and implement a strategy to reduce provincial government energy expenditures through an interdepartmental committee which establishes targets, identifies initiatives, coordinates activities and monitors results.

Provide energy analyses to provincial and municipal government agencies and small business to identify opportunities to reduce energy costs.

Identify barriers to the implementation of energy management recommendations; develop and initiate appropriate measures to overcome such barriers.

Examine methods of reducing the perceived financial and technical risk of retrofit activities. Encourage innovative financing mechanisms and a more effective use of energy consulting services.

Identify energy management opportunities in specific sectors such as agriculture, fish processing and sawmilling, and through various information transfer activities, make management aware of the opportunities.

In cooperation with the federal government, demonstrate new or evolving energy management technologies and assist in the development of energy efficient products.

Transportation

Develop and implement an information program for the trucking industry, both line-haul and city delivery, identifying the savings available from improved energy management.

Examine appropriate mechanisms and develop a strategy to implement traffic management improvements in urban/suburban areas throughout the province in cooperation with the Department of Municipal Affairs.

Promote ride-sharing programs in urban areas and near large rural plants by presentations to employers and employees, advisory services and publicity campaigns.

SUGGESTED ELECTRICAL INITIATIVES

Provide a public information program on the technology and economics of using heat pumps for space heating and waste heat recovery.

Examine the economic and technical feasibility of small-scale co-generation facilities fueled with chipped forest residue.

Undertake a demonstration project to determine the benefits of electric plenum heaters in terms of improved utility load and reduced oil consumption, and the effects on the consumer.

Evaluate the effectiveness of the Health Services Tax rebate for the unconventional portion of wind generating systems, and continue it if warranted.

Monitor technological changes and improvements in small-scale wind generation, and, if appropriate, encourage further demonstration projects in the 25 to 150 kW range in order to assist small-scale wind generating manufacturers.

Continue to monitor the feasibility of developing large scale tidal electric generating facilities to supply both domestic and export markets.

Complete a resource evaluation of the geothermal potential in the Springhill area, and if the results are positive, undertake an electric heat pump demonstration project to provide necessary technical and financial information to potential producers.

Assess the potential of geothermal energy in areas other than Springhill.

SUGGESTED FOREST BIOMASS INITIATIVES

Undertake an information program to ensure that potential consumers are aware of the technology available and the economics of chip consumption.

Encourage the substitution of wood chips for petroleum products as fuel in government owned buildings, and undertake demonstration projects to encourage small energy users to convert to wood chips.

Study and evaluate opportunities for using forest biomass to cogenerate steam and electricity at potential sites in the province. Encourage the adoption of this technology where technically and financially attractive, through demonstration, technology transfer and other means.

Encourage feasibility studies on conversions from fossil fuels to wood chips by providing information programs on such funding mechanisms as innovative third party financing.

Collect and evaluate cost and production information on chipped biomass under different operating conditions.

Study, assess and publicize the economic impact of wood chip production under such categories as job creation, taxation, manufactoring and service industry opportunities, benefits to the forest industry, etc.

Undertake a comprehensive study of the long-term effects of harvesting logging residues and unmerchantable timber, and of the effects of increased wood combustion.

SUGGESTED OFFSHORE GAS AND OIL INITIATIVES

Offshore Exploration

Increase liaison with the land departments of offshore operators and potential operators to ensure that exploration opportunities in Nova Scotia are fully appreciated.

In cooperation with the federal government, develop a policy for the expeditious issuance of new lands to ensure maximum access for interested operators.

With the federal government, establish a stable regime for offshore operations, including an attractive generic royalty structure to encourage further exploration, by early revision of the Offshore Oil and Gas Act and the Canada-Nova Scotia Offshore Agreement.

Gain assurances from the governments of Canada and Newfoundland that Hibernia oil production will be allocated to Atlantic refineries.

Onshore Oil

Engage in timely negotation of onshore exploration agreements with existing license holders, as well as making new lands available on a competitive basis.

Complete the necessary technical studies to correlate existing geological data and to provide a comprehensive overview of onshore petroleum potential.

Natural Gas Liquids

Enter discussions with the federal government to make available the same grants or tax reductions to encourage the use of propane in motor vehicles as are presently available in other areas of the country.

Support a training course to ensure that vehicle conversions take place efficiently, and that vehicles are subsequently properly maintained.

Evaluate Metro Transit's experience with propane as a vehicle fuel.

Study the possibility of converting part of the government vehicle fleet to propane.

Publicize the benefits of using propane as a vehicular fuel.

Consider tax rebates to encourage the conversion of vehicles to propane.

Continue to monitor the feasibility of prebuilding a market for natural gas through the construction and operation of an underground distribution system to supply propane to residential, commercial and industrial users who will eventually be connected to gas services.

Natural Gas

Study the technical aspects of offshore pipelining to ensure that adequate capacity will exist to handle the additional volumes of gas generated by continued exploration.

Undertake discussions with the federal government to ensure that gas marketing assistance is provided in a manner similar to that provided in Central Canada under the National Energy Program.

Update past studies on the manpower required for burner conversions to natural gas in all sectors, and implement appropriate burner and furnace conversion and maintenance training programs.

Provide the body responsible for regulating domestic distribution and marketing of natural gas with sufficient staff support to ensure efficient regulatory review.

Encourage the use of natural gas as a vehicle fuel, possibly using tax rebates or exemptions.

SUGGESTED COAL INITIATIVES

Encourage the development of a new mine by the early 1990s to supply both domestic and export markets.

Continue the activities of the Nova Scotia Department of Mines and Energy Coal Exploration group in order to carry out active exploration programs in the four major coalfields, and to provide the industry with an ongoing evaluation of new information and coal mining opportunities.

Continue Nova Scotia Research Foundation Corporation (NSRFC) development work on the two-stage coal liquefaction process.

Undertake a small demonstration project in a local industrial/commercial plant to demonstrate the economic and technical viability of fluidized bed combustion.

Study the economic viability of establishing a central washing, blending and shipping facility near a deep water port. This would encourage exports by enabling Nova Scotian coal producers to penetrate offshore thermal coal markets with a blend of washed coals consistent with the more stringent coal specifications of foreign markets.

Continue work on the creation of a detailed computerized coal data bank which incorporates all of the existing exploration data and is updated as new data is generated.

Continue research into stable coal liquid fuels, emphasizing the problems of viscosity difference and particle size and distribution differences.

Study the viability of utilizing tailings and fine wash plant rejects in a coal-liquid fuel process.

Continue research into the transportation, freezing and handling problems associated with coal liquid fuels.

Finalize coal gas regulations to provide an attractive and stable regulatory regime.

Negotiate coal gas agreements with the existing license holder in a timely fashion.

Encourage further demethanization projects, and maximize the production of coal gas, where economic.

Study the economics of gasifying some of the province's higher sulphur coals, considering both costs and potential markets.

SUGGESTED PEAT INITIATIVES

Determine the production capacities of peat deposits in the province within reasonable levels of confidence by a harvesting demonstration under average environmental conditions.

Evaluate potential markets for peat fuel and peat products in eastern Canada.

Determine the compatability of existing solid fuel combustion units used or manufactured in Nova Scotia with peat available from southern Nova Scotia.

Establish available reserves using detailed surveys of the most feasible deposits.

Encourage nongovernmental organizations to participate in research that leads to enhanced production capacities from peat bogs, reduced transportation costs and minimized environmental impacts from bog development.

Develop a comprehensive management policy towards Crown owned peatlands to ensure both a fair return to the province and development practices that are both fiscally and environmentally sound.

Compile a bibliography of literature pertaining to peatlands and develop a "user friendly" data base system to allow easy manipulation of the inventory data from earlier studies.

SUGGESTED MUNICIPAL SOLID WASTE INITIATIVES

Carry out site-specific feasibility studies, including evaluations of capital cost requirements, equipment options, land availability, available consumers, and cost-benefit implications

Concurrently, study the financing options for municipal waste fuelled energy plants to find those most appropriate for Nova Scotia.

Review the potential of steam production using industrial waste.

Study the possibility of supplementing municipal solid waste with chipped wood in areas of the province which have a suitable customer for the steam which a MSW plant could produce, but insufficient municipal solid waste to support a cost-effective installation.

SUGGESTED SOLAR AND GEOTHERMAL INITIATIVES

Solar

Continue the Solar Greenhouse Course coordinated by Department of Mines and Energy staff, and assist in updating the course as required.

Monitor developing solar technologies and solar demonstration projects to provide up-to-date information. Undertake additional demonstrations where warranted.

Evaluate the policy of rebating the Health Services Tax on components of active and passive solar systems (expanded in 1984 to include photovoltaic).

Geothermal

Complete a resource evaluation of the geothermal potential in the Springhill area, and if the results are positive, undertake a demonstration project to provide necessary technical and financial information to potential producers.

Assess the potential of geothermal energy in areas other than Springhill.

SUGGESTED CRUDE OIL SUPPLY INITIATIVES

Encourage exploration and development of petroleum sources offshore Nova Scotia and Newfoundland in order to replace foreign supplies with indigenous.

Encourage the use of east coast offshore oil such as Hibernia oil, in Atlantic refineries. Such oil, while outside Nova Scotia, is much more secure than foreign supplies.

Encourage the use of petanes plus from any Scotian Shelf gas development as a refinery feedstock replacement for foreign oil.

Monitor international oil markets in order to anticipate future problems.

Request assurances from the federal government that facilities will be constructed to deliver western crude to the East Coast during emergencies.

Update the Provincial Petroleum Emergency Plan to minimize negative impacts on consumers during an emergency

Participate on federal/provincial committees which liase with the International Energy Agency, coordinators of emergency planning in OECD countries.

Part 1.

The Energy Environment

1. THE ENERGY ENVIRONMENT

1.0 INTRODUCTION

Energy Planning — a challenge and an opportunity

In late 1979, the Nova Scotia Department of Mines and Energy published Energy: A Plan for Nova Scotia. The 1979 Energy Plan was the first comprehensive energy planning proposal produced by the Government of Nova Scotia. It followed from the unexpected and economically devastating world oil price and supply shocks of 1973 and 1978-79 which demonstrated Nova Scotia's precarious dependence on foreign oil.

The 1979 Energy Plan evolved from a realization that the energy sector was critical to overall economic planning and development because of the impact of energy pricing on industrial and commercial development, as well as on public and private budgets. On the one hand, energy considerations are now among the chief constraints on and challenges to economic planning; on the other, energy planning has begun to be appreciated as a potential development tool, providing new economic policy options. Other economic factors remaining equal, import substitution in the energy field can bring major economic and employment benefits.

Both in purpose and in content, this document is an updated energy plan which both builds in the achievements of the 1979 document and takes into account significant changes in the energy environment since 1979. Its purpose is fourfold: (1) to review the thrusts of the 1979 Energy Plan in light of the dramatic changes that have since occurred in the energy sector at both the international and national levels; (2) to provide a fresh "benchmark" or status report of the conditions existing in 1985; (3) to suggest how the energy sector is likely to develop in the next decade or so; and (4) to suggest broad policy options to minimize emerging difficulties and maximize emerging opportunities.

The first two purposes are the most easily handled objectives since both are based on existing facts and situations. The third goal -- projecting the future -- is by far the most difficult. Views that seemed axiomatic in 1972 were clearly wrong by 1974; the experts' best guesses in the mid-seventies were completely upset by events in 1978-79; and assumptions that seemed valid in 1979-1980 had to be drastically revised by 1982-83. Internationally, the energy sector has been dismayingly volatile in the past dozen years and the future seems no easier to predict.

Increasingly, flexibility is seen as the key to energy planning. The 1979 Energy Plan expressed the concern that it was working in areas of uncertainty with respect to future pricing and demand; to new developments in technology; to the way in which the energy sector affects economic planning, investment and employment; and to future federal government response and policies. The intervening five years have proved the concern to be well founded.

Energy Plan, 1985 works within similar constraints. It should be noted, however, that despite all of the limiting factors, the broad thrusts of the 1979 Energy Plan have been implemented with considerable success, and the worth of such planning validated.

One critical difference should be noted between the 1979 Energy Plan and **Energy Plan, 1985**. In 1979, little research existed which dealt with the provincial energy sector in a coordinated manner. The 1979 Energy Plan recommended energy policies following a broadly-based committee review involving government, the private sector and public organizations. The Plan was successful, although it was formulated in extremely demanding circumstances.

The basis of **Energy Plan, 1985** is quite different. The 1979 Energy Plan exists as a touchstone, and the Department of Mines and Energy now has a well-organized and coordinated process of information collection and policy formulation. Accordingly, this document is put forth as an accessible source of information and departmental policy recommendations to which interested individuals and groups can respond. This approach should contribute to an informed discussion of the issues, in which all points of view can be canvassed and represented prior to the submission of policy proposals to Executive Council.

Energy Plan, 1985 is divided into three Parts. Part One reviews the international, national and provincial environments within which the planning process must operate. Part Two describes Nova Scotia's energy planning resources, including the province's natural resources, energy efficiency potential and the provincial energy model. It also describes the results of the **status quo** case, or the forecasts generated by the model if no new initiatives take place. Part Three looks at ways in which the results of the **status quo** scenario could be improved, describes the changes in the forecast which might result from new initiatives, and suggests options which could achieve the optimum or **target** scenario.

Part One begins with a review of the historical background and the current situation at both international and national levels and is designed to place the possibilities and limitations of provincial energy planning within a broader perspective. As the dynamics of international oil pricing continue to elude definitive analysis, national energy policy is undergoing major alterations at both the philosophical and program levels. Any provincial plan must work within the limitations imposed by national policy. Part One concludes with a parallel review and summary of the provincial situation, including a review of the main policy thrusts of the 1979 Energy Plan and a summary of the recommendations and their implementation.

Part Two commences with a description of Nova Scotia's energy resources, since the foremost requirement for a provincial energy policy is a clear understanding of all existing and potential indigenous energy sources. The effects of increased energy efficiency and future energy management improvements are then discussed. Part Two concludes with a description of the provincial energy model and discusses the supply/demand forecast in the absence of any new policy initiatives (the **status quo** case).

Part Three describes the **target case**, which is an extension of the **status quo** forecast, incorporating the effects of realizing such opportunities as improved energy efficiency, additional natural gas production and technological innovations. The **target case** describes an energy future which achieves the optimum balance of our energy constraints and of our energy opportunities, and characterizes the broad policy initiatives required to achieve it.

Part Four contains the appendices.

1.1 THE INTERNATIONAL STAGE

Background

A comprehensive energy policy must take into consideration the unavoidable fact that international oil pricing and political developments will have a major impact on any regional energy policy. Oil and gas are obviously not the only available energy sources: there are also coal, hydro, biomass, other renewables and nuclear. Energy policies, however, usually commence with petroleum products because it is oil that continues to set the international price structure of the energy sector.

Oil Pricing and Economic Growth

The experience of the last dozen years is indicative of the "chicken and egg" relationship between international energy prices and economic growth. When energy prices were low and stable, most commentators forecast continuous economic growth. The shock of the first OPEC price hike in 1973 is generally agreed to have been a prime cause of the disruptive inflationary trends that wracked the world economy in the mid-1970s. Nonetheless, real economic growth continued (although at a much lower rate) and end-use energy demand per unit of constant dollar Gross National Product (GNP) fell only marginally.

By 1977, the price of oil seemed to have stabilized at under (US1983) $20/barrel, and almost all commentators forecast substantial continued growth in energy demand and real GNP, with relatively little change in oil prices.

Unfortunately, the relative success with which the economies of the industrialized world coped with the 1973 price hike, together with the effects of the Iranian revolution, contributed to the new and unexpected price hikes of 1978-79. Suddenly, all the forecasts changed. Commentators now projected continuing energy price increases. Because energy demand was assumed to be relatively insensitive to modest energy price increases, they also forecast continually growing energy demand.

The Situation in 1979

In 1979-80, it was generally considered that the major effects of the 1978-79 price hike would be similar to those that followed the first increase in 1973. Forecasters reasoned that because energy would cost more, all prices would go up, putting economies under considerable inflationary pressure. As more money was spent on importing energy resources, less money would be available to purchase domestically produced goods. Economic growth would slow and unemployment would rise.

This was not welcome news, but at least the experience gained between 1973 and 1978 suggested that a planned response was possible. Conservation, import substitution, accelerated development of internal resources, regulated price stability as opposed to market swings, internal security of supply -- all seemed like the appropriate responses for most industrialized nations.

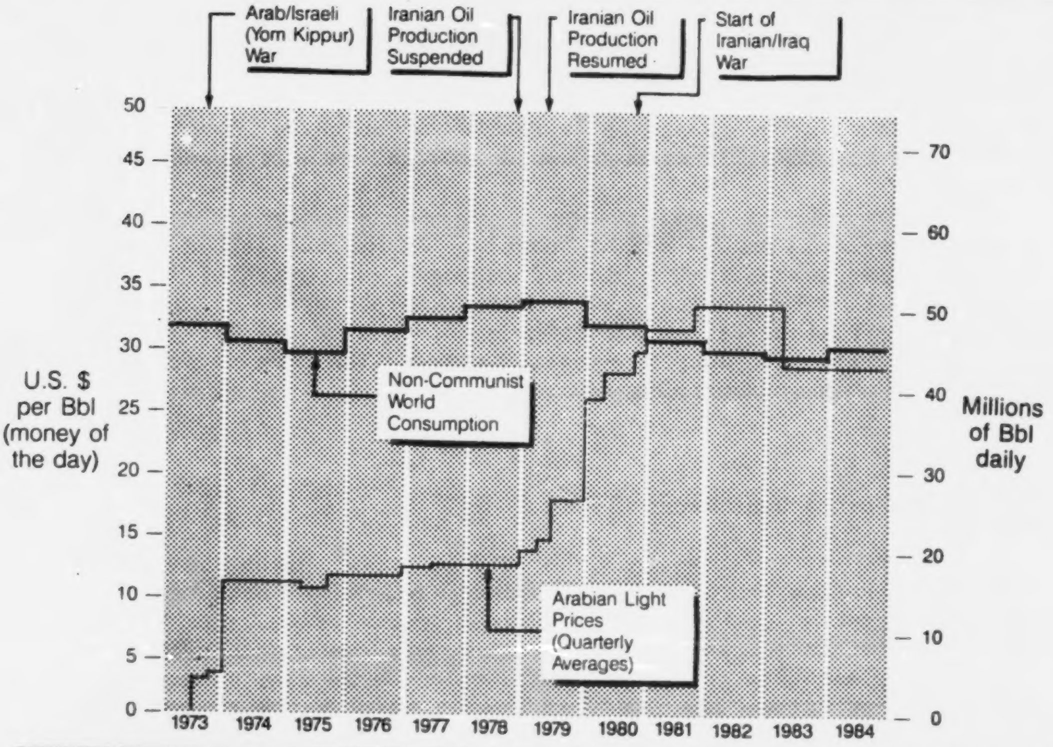
Where the Forecasts Went Wrong

What happened instead was that the 1978-79 price hikes themselves affected in unforeseen ways the forecasts regarding both economic growth and increased energy demand. Higher energy prices, as well as the forecasts of continuing price increases undoubtedly contributed to an absolute reduction in energy demand as conservation became perceived as an economic imperative. At the same time, the conservation efforts of the early 1970s began to "bite" as older capital stock (such as buildings, machinery, transportation vehicles) was gradually replaced by more energy efficient models.

In addition, the shock to the world economy from vastly higher energy costs contributed to the recession of 1982, which in turn lowered energy demand even further. Finally, concerns about security of supply led to oil substitution policies in many countries, as well as to large-scale investment in domestic oil and gas exploration and development, including increased attention to non-conventional sources.

In short, a "push-pull" incentive to reduce dependence on imported oil developed throughout the industrialized nations. The "push" was increased energy costs and concerns over security of supply; the "pull" was that the higher price of oil made such options as new conservation technologies and indigenous or alternative resource development economically viable. Overall, world oil consumption declined about 6.5 million barrels per day between 1979 and 1983 (see Figure 1-1). About two-thirds of this reduction was probably due to conservation, and the remainder to slower economic growth.

FIGURE 1-1 WORLD OIL PRICES AND CONSUMPTION, 1973-1984



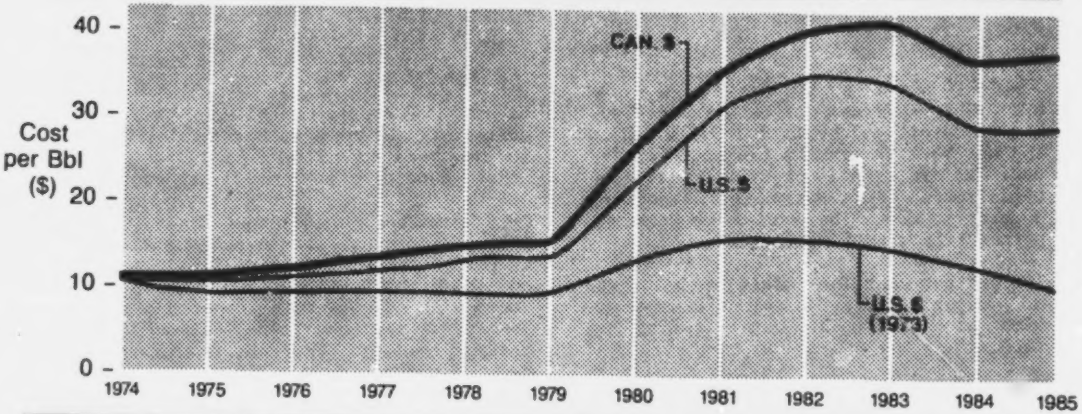
Source: BP Statistical Review of World Energy, June 1985, pps. 8, 12, 13.

The Effect on the Organization of Petroleum Exporting Countries (OPEC)

Lowered demand in turn upset the revenue projections of the oil-producing countries. As demand dropped, producers felt the pressure to maintain or increase their market share in order to minimize their revenue losses. Non-OPEC producers dropped their contract prices and Nigeria, an OPEC member, followed suit in order to stay competitive with North Sea oil. OPEC then agreed upon an official reduction in its price of Saudi light (generally accepted at that time as the benchmark for international pricing) from (US)$34 per barrel to (US)$29 per barrel in March, 1983 (see Figure 1-2). In an attempt to prevent an oversupply of oil from dropping prices further, OPEC also agreed to lower its production quota from 18.5 to 17.5 million barrels per day.

Supply continued to outrun demand, however, and spot oil prices remained considerably lower than official OPEC prices on international markets. Nigeria again broke away in October 1984, lowering its price to (US)$28 per barrel. OPEC first reacted by cutting the production quota to 16 million barrels per day. In January 1985, nine out of 13 cartel members agreed to further lower the price for benchmark Saudi light crude by about $1 per barrel.

FIGURE 1-2 PRICES FOR ARABIAN LIGHT OIL, 1974-1985



Source: BP Statistical Review of World Energy, June 1985, pp. 13.

In December 1985, OPEC responded strongly, if somewhat ambiguously to its reduced market share. Although OPEC production at that point was around 18 million barrels/day, the organization unanimously proclaimed that it was not getting a "fair share" of the non-communist world (NCW) market. While making it clear that its future priority would be to defend market share rather than market price, OPEC did not clarify what a "fair share" would be, but rather appointed a committee to study the matter. Individual OPEC oil ministers had variously suggested that an appropriate share would be something between the 16 million barrels/day self-imposed ceiling and 20 million barrels/day.

The Present Situation

The difficulties in predicting international energy costs were highlighted in the first few days of 1985, as markets responded to a crucial OPEC conference held the week before. A New York Times report of the situation (January 3, 1985) gives a graphic picture of the difficulties in predicting energy pricing (see Box 1-1). Market psychology has clearly joined the host of other imponderables in forecasting oil prices.

Major changes continued to occur in the overall market. In April 1985, for example, Britain announced plans to abolish the government-run British National Oil Corporation because it could no longer effectively stabilize oil prices. This is consistent with an emerging tendency in many countries to move pricing decisions away from political control and back to the market. Although the overall effect of such a trend is not totally clear, it adds to the increasing importance of the daily or spot market which has grown considerably in the last few years. As of March 1985, for example, about 80 percent of oil was sold on the spot market compared with 40 percent in 1984 and 2 percent in 1978.

Box 1-1

NEW YORK TIMES NEWS SERVICE REPORT

(January 3, 1985)

NEW YORK — Prices for future delivery of crude oil and heating oil plunged on the New York Mercantile Exchange yesterday, as oil traders predicted that the Organization of Petroleum Exporting Countries would be unable to prevent prices from crumbling further.

The prices were the lowest since crude oil began trading on the exchange in 1983 and heating oil began trading in 1978.

The dramatic drop in prices was the first clear reaction by the market to the OPEC conference last week in Geneva, and reflected doubts by many analysts and traders that the conference achieved anything.

In the first trading day since the conference ended Saturday, the price of crude oil to be delivered next month fell 48 cents (U.S.) a barrel, or more than 1 cent a gallon, to $25.92 a barrel. Virtually no crude oil traded hands Wednesday in the spot markets, but if similar prices reign there they would be the lowest since the revolution in Iran pushed prices up at the end of 1979. . .

These sharp drops will place considerable pressure on OPEC and such other oil producers as Britain and Norway to cut their prices. Buyers may be unwilling to pay the official OPEC price of $29 a barrel for Arabian Light when they can purchase a slightly more desirable grade in New York for under $26, although other considerations sometimes apply...

OPEC ministers had hoped that their price adjustments, and a plan to monitor output to prevent members from cheating on their production quotas, would reverse a market psychology that has been pushing prices lower since October. But traders reacted in just the opposite way, deciding that OPEC had achieved nothing and that prices will continue to fall.

Another factor pushing down oil prices was a 30-day forecast of continued mild weather in some of the colder regions. Warm temperatures reduce the demand for heating oil and crude oil, and so result in lower prices.

Although most of the future's trading on the Mercantile Exchange is on paper — less than 2 percent of the oil traded is ever actually delivered — video screens reporting the latest fluctuations are carried instantly to traders all over the world, and have an increasingly important effect on the spot markets and even contract prices. Spot markets typically follow the exchange in direction, but the price changes are usually less.

Immediately following the OPEC announcement of December 1985, oil prices plummeted. North Sea oil, which a fortnight before had been selling for (US)$31/barrel, dropped to (US)$22. In the United States, prices dropped to $25/barrel. The situation is not likely to resolve itself until the spring of 1986, when OPEC clarifies its position and seasonal demand drops. If prices drop unrealistically low, conservation and exploration efforts will be hampered, and the price rises and renewed dominance of middle-east reserves predicted for the 1990s are likely to occur earlier.

The Dangers of a Sudden Price Drop

As oil prices started falling in 1983, new and unforeseen stresses emerged in the international economy. In fact, the main concern expressed by analysts since the start of 1985 is not of a disastrous price rise, but of a disastrous price collapse. The possibility existed that a major drop in prices would cause OPEC solidarity to dissolve, leading to a price war as producing countries attempt to maintain oil income by increasing sales. Now the possibility of a price war between a united OPEC and competing countries must also be considered.

The effects of such scenarios could be incalculable. Energy costs and energy revenue are so closely intermeshed with the world economy that a major change in one results in serious shocks to the other. The results of an uncontrolled drop in prices is sufficiently contrary to the interest of all parties, however, that common sense suggests it will not be considered an ultimate solution.

A massive drop in oil prices would have its greatest impact on the cash flow of all energy producers, both national and corporate. This, in turn, would affect the financial institutions supporting them. A drop in oil prices, however, could also lower the inflation rate in most industrialized countries and, in turn, the interest rate. Since many energy producers are also heavily indebted, this could offset the effects of lower prices. To complicate matters further, a major price drop could easily trigger increased economic growth and a corresponding rise in energy demand. But, if the drop were so large or so precipitous as to create lower confidence in the world economy, the immediate effect could be the opposite.

Table 1-1

REVENUE AND DEBT CHARGE CHANGES
(US$millions)

	Revenues	Debt Changes
	$1 drop in average oil prices	1% fall in average interest rates
Argentina	0	+ 400
Brazil	+ 300	+ 1000
Chile	+ 30	+ 180
South Korea	+ 180	+ 335
Mexico	- 515	+ 750
Nigeria	- 555	+ 170
Venezuela	- 525	+ 335

Source: The Economist, July 6, 1985, p.20

Canada, as a producing nation which also has a strong industrial base, has a particularly keen, and to some extent ambiguous, interest in oil price increases and decreases. Individual Canadian consumers are naturally in favour of lower prices. As a producer, however, Canada also has a strong interest in seeing that oil prices do not drop precipitously because of the negative impacts on both government revenues and the economic viability of frontier and unconventional energy resources.

The Effects of Currency Fluctuations

Finally, the effects of the strong U.S. dollar through 1983 and 1984 must be borne in mind. International oil prices are always quoted in U.S. currency and, while they seem to have dropped dramatically since the 1981 high, this is only in terms of the U.S. dollar. Since the U.S. dollar has concurrently risen against other world currencies, the price of oil has either risen or dropped much more slowly for many other countries.

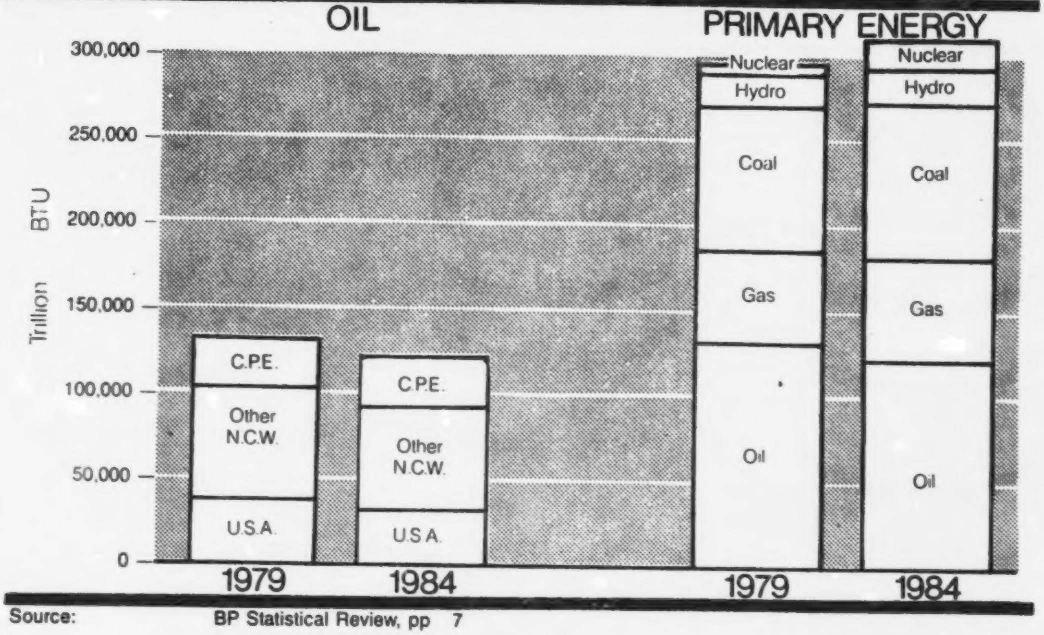
To the extent that energy prices and economic growth interact, the impact of dropping oil prices has not yet been fully felt in the world economy. If the U.S. dollar were to weaken against other currencies, or if the price of oil were tied to some standard other than the U.S. dollar, oil prices would drop in real terms for the Common Market countries at least; and demand might increase, putting pressure on prices to increase.

On the other hand, the OPEC producers have, to some extent, been sheltered from oil price drops by the fact that, although they are receiving fewer U.S. dollars, their purchasing power has not decreased due to a stronger U.S. dollar, especially in western Europe. However, a drop in the U.S. dollar would affect their internal budgeting, even if the price of oil remained constant, and could lead to renewed pressure for increased production.

The Possibility of Growing Demand

Crude oil consumption in the non-communist world rose by over 2 percent in 1984, the first such growth since 1979, and total primary energy consumption grew by twice as much. Figure 1-3 provides a comparison of consumption patterns in 1979 and 1984. Since the economic growth rate was almost five percent, the increase in energy consumption can be primarily attributed to economic expansion rather than to a rise resulting from energy intensity. However, it may also be an indication that the conservation and oil substitution policies undertaken in the past several years are reaching a plateau.

FIGURE 1-3 WORLD CONSUMPTION OF OIL AND OF TOTAL PRIMARY ENERGY, 1979, 1984



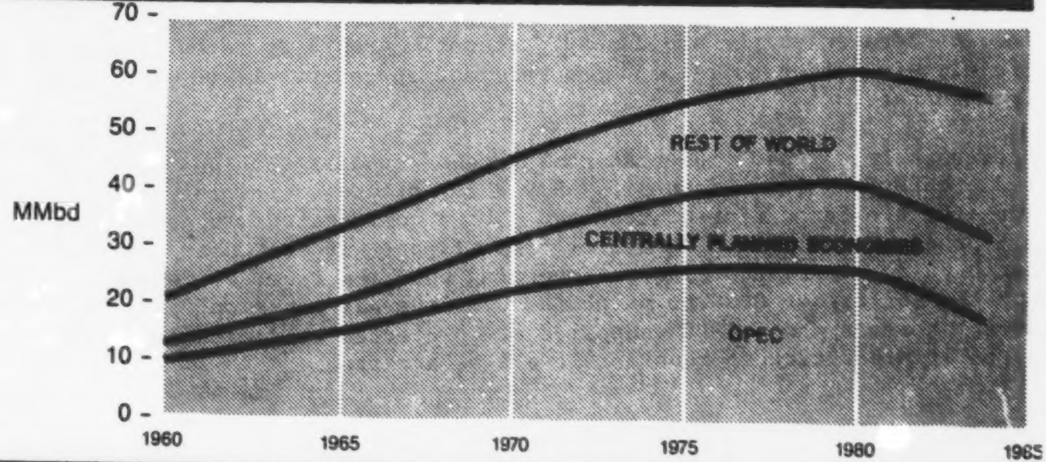
Source: BP Statistical Review, pp 7

Note: N.C.W. = Non-Communist World
C.P.E. = Centrally Planned Economies

How Long Will Supply Expand

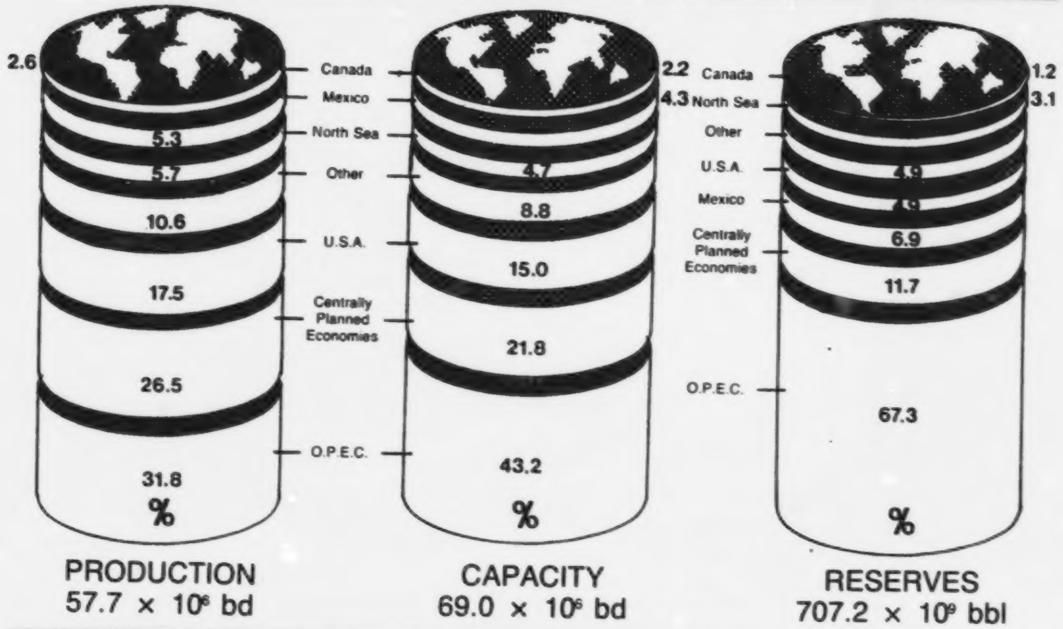
It is easy to see at least one result of the price shocks of the 1970s: vastly increased production by the non-OPEC, non-communist countries as a result of stepped-up exploration and development programs (see Figure 1-4). However, most of this increase comes from three major production areas: Mexico, the North Sea and the Alaskan North Slope. It is therefore important to consider the remaining reserves of those areas (see Figure 1-5).

FIGURE 1-4 WORLD OIL PRODUCTION, 1960-1984



Source: The National Energy Program Update, 1982, pp. 11.
BP Statistical Review of World Energy, June 1985, pp. 4.

FIGURE 1-5 WORLD OIL PRODUCTION: CAPACITY AND RESERVES, 1984



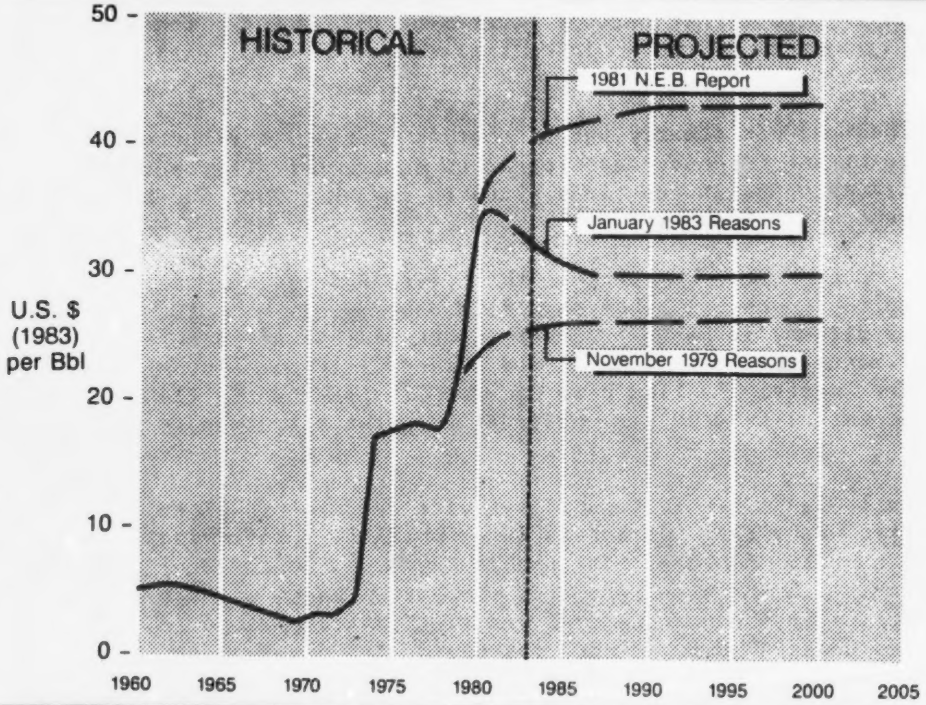
Source: BP Statistical Review of World Energy, June 1985, pps. 2, 5.
Nova Scotia Department of Mines and Energy

The Limits to Planning

Figure 1-6 illustrates the range of views taken on future world oil prices by submissions to the National Energy Board in 1984 compared to other NEB projections since 1979. In short, it represents the best judgement of a range of Canadian experts over the past half-dozen years. Clearly, the variance indicates that international energy prices are difficult to forecast and that certainty is impossible. The challenge is to gain as full an understanding as possible of the dynamics between supply and demand, economic growth or recession, and pricing, in order to respond promptly and appropriately to changing circumstances.

Unfortunately, the international scene appears to be no more predictable in 1985 than in 1979-80, although it is arguably unpredictable for different reasons. Most commentators suggest that oil prices will remain stable or drop slightly in the near future, possibly even into the 1990s, depending upon the level of demand and upon the ability of OPEC to maintain some internal cohesion. By the 1990s, however, non-OPEC supplies are projected to decline and OPEC may be in a position to reassert itself as a cartel.

FIGURE 1-6 WORLD OIL PRICE PROJECTIONS



Source: Canadian Energy Supply and Demand, 1983-2005, Technical Report, National Energy Board, September 1984, pps. 1, 7.

Summary

It is probably safe to assume that oil is not likely to regain its pre-1979 share of the energy pie. We cannot, however, assume that oil's share of energy consumption will continue to decrease to the same extent as in the early 1980s. Indeed, if the world economy continues to strengthen, the 1984 rise in world oil consumption could indicate a renewed upward trend. It is quite possible that by the 1990s, OPEC will once again be able to effectively dictate world oil prices. However, given the experience of the last half decade, it is probable that a more moderate approach will be taken.

The energy sector has experienced considerable turbulence since 1979. Even if we assume that the storm is abating, there will undoubtedly be some unexpected gusts before it blows itself out. In brief, it is probable that the best that can be hoped for is as little change as possible. If prices remain stable or change marginally, most countries will be able to develop and implement middle- and long-term energy policies more successfully. However, an energy plan cannot lose sight of possible supply and pricing difficulties or crises which could arise from a re-grouped and strengthened OPEC particularly as non-OPEC reserves dwindle.

Perhaps the greatest danger is that having over-reacted to projections of increasing demand and security and pricing problems in 1979-80, policy-makers might now overcompensate. We are in a situation where, against all predictions, demand and prices have temporarily dropped, and OPEC's share of the international market has been dramatically reduced. It is important that neither government nor industry react in a full-scale reversal of the policies implemented to deal with the 1979 price shocks.

The potential danger was clearly put by Charles Ebinger, a director of the Energy and Strategic Resources Program at Georgetown University's Centre for Strategic and International Studies in a May 1985 interview with U.S. News & World Report:

> Clearly, OPEC will be back in the driver's seat in the 1990s. Since most oil that can be produced by non-OPEC countries already is being produced, each additional barrel of oil needed to meet rising world demand will come from OPEC. The cartel is likely to increase its share of the world oil market from 27 percent today to about 55 percent.
>
> . . .
>
> There will be more oil found, but with major new giant discoveries appearing more and more unlikely; worldwide production will decline. It appears that the North Sea, particularly the British sector of the North Sea, may go into decline in the next several years. The North Slope in Alaska and Lower 48 U.S. production may do the same thing. Although Mexico intends to boost production by 1.5 million barrels a day in the next five or six years, only 300,000 barrels of that will be for export...
>
> . . .
>
> People forget about the long lead time it takes to develop new energy resources. Now, 1990 may seem like a long time to the general public and an administration concerned about policy between now and the 1986 congressional elections. But 1990 is already history in terms of energy supply.
>
> . . .
>
> It takes 12 to 14 years on average to build a nuclear-power plant, something like 6 to 8 years for a coal-powered plant. Oil discovered in Alaska today will not be available to consumers until around 1995. So without investment in energy projects today, we now may well be creating the seeds of our next oil shock in the 1990s. (pp.37-38)

Thus the situation of the late seventies could easily recur in the late eighties. It would be ironic indeed if government and industry reacted to the errors of their short-term projections half a decade ago by abandoning the very policies required to deal with the re-emergence of those same problems half a decade from now. Although the drop in the world price of oil may have temporarily altered the economics of indigenous resource development and substitution, it would be perilous to view the present situation as anything more than a welcome breathing space.

1.2 THE NATIONAL SCENE

Background

Just as international events set the stage for national energy planning, so national events and policy in turn set the stage for provincial energy planning. The national backdrop influences such factors as overall supply and demand projections for energy, and pricing assumptions which, although largely driven by international developments, can be affected far more by national than by provincial policy planning.

Supply projections are affected by assumptions on international pricing and the consequent economic viability of various indigenous resources. Similarly, overall demand projections can be viewed either as driven by economic development assumptions or as an "engine of growth" in themselves. Essentially, it is another "chicken and egg" situation in which planners are never quite certain which assumption is the **sine** qua non, the accuracy or inaccuracy of which will most critically affect the other assumptions.

In 1979, the critical assumption appeared to be that domestic energy prices would continue to rise, driven by the combination of growing demand and OPEC-generated concerns about security of oil supply. This seemed a reasonable assumption at the time and became the crux of the national energy policy in response to international events.

The National Strategy

In fact, increased self-sufficiency, security and price protection had been national goals since the implementation of the National Oil Policy (NOP) in 1961. At that time, the area to the west of the Ottawa Valley was reserved as an exclusive market for domestic oil to ensure that western Canadian producers had the security required for long-range planning and development. In the 1970s, this policy was further strengthened by an agreement between the Government of Canada and Inter-Provincial Pipelines to extend the national pipeline system to Montreal. Upon completion in 1976, the pipeline allowed western crude to displace 250,000 barrels per day of imported oil.

Additionally, after the 1973 OPEC increases, a series of federal-provincial agreements established a considerable measure of control over the pricing of domestically produced oil. Imported oil was subsidized under the Oil Import Compensation Program to ensure a single price for crude oil in Canada subject to transportation differentials. The essential policy thrusts were that Canadian consumers and Canadian industry should enjoy an equalized price throughout the country, that they should be protected from the erratic swings of international pricing, and that Canada's good fortune in having large quantities of oil should be translated into a competitive advantage for Canadian industries.

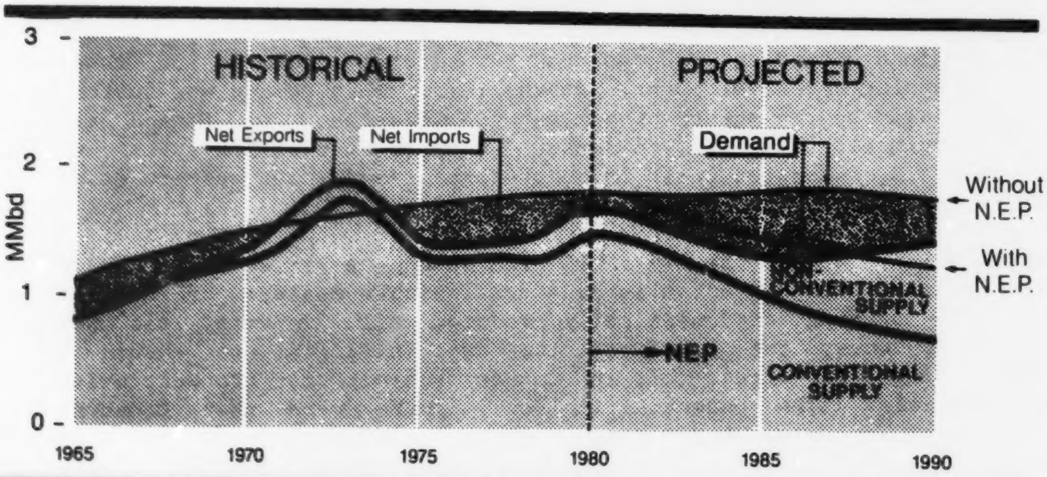
Background to the National Energy Program (NEP)

Nonetheless, concerns about continuing self-sufficiency grew as long-term supply projections worsened. The National Energy Board recommended that exports be curtailed, and when this policy was implemented in 1975 exports dropped from 1.2 million barrels per day to 460,000 barrels per day. Heavy crude oil gradually became a larger component of exports as Canadian refiners were unable to utilize all of production. Light crude exports were phased out entirely in 1979, except for a few "exchange" situations whereby Canada supplied refineries in the U.S. northwest in return for an equivalent amount of United States imports into Ontario and Quebec. During this period, domestic natural gas prices were linked to the crude oil price by federal-provincial agreement, with eastern Canadian gas prices at approximately 85 percent of domestic wholesale crude oil prices in 1976.

The National Energy Program (NEP)

By 1980 when the National Energy Program (NEP) was introduced, Canada had become a net importer of crude oil, with this situation projected to worsen by the mid-1980s (see Figure 1-7). The NEP set out to reverse this trend, on the prevailing assumptions of continuing OPEC domination of supply and price, and steadily increasing demand.

FIGURE 1-7 CANADIAN OIL SUPPLY AND DEMAND: EFFECT OF NEP



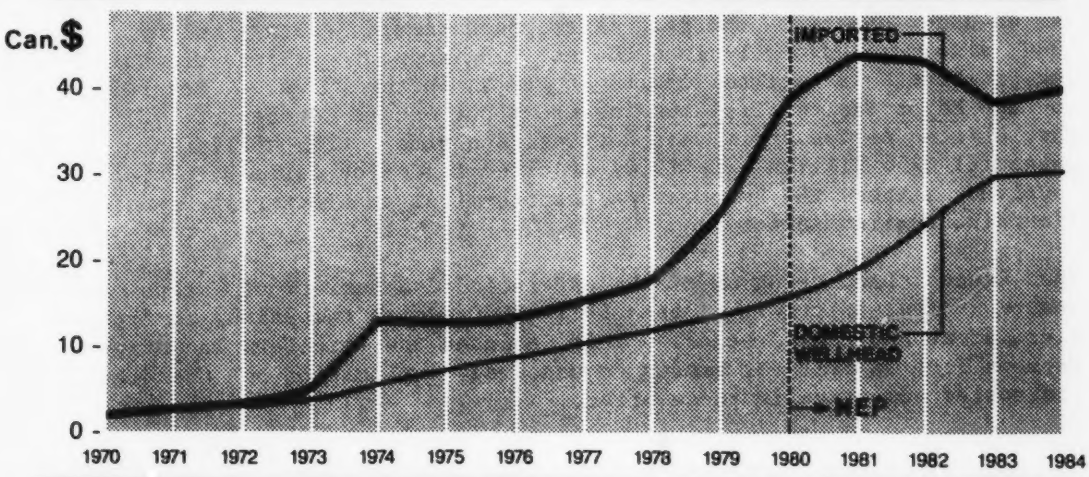
Source: The National Energy Program, 1980, pps. 9, 99.

The main goals of the NEP were: (1) to increase oil reserves by encouraging exploration and non-conventional production; (2) to Canadianize the industry so as to maximize the economic spin-offs; (3) to reduce oil demand by substitution and conservation measures; and (4) to maintain an equalized price across the country, protected by regulation from the ups and downs of the international market, and to keep it significantly below world prices. The NEP targets for 1990 were restored self-sufficiency in oil, 50 percent Canadian ownership of oil and gas production, and a 20 percent reduction in oil consumption.

The program set forth to realize these objectives had two main thrusts. The first was a pricing and taxation regime designed to encourage increased exploration and development for oil and gas, especially in frontier areas or from non-conventional sources, and the Canadianization of the oil and gas industry. The second was oil substitution through improved energy efficiency and conversion to indigenous energy resources.

The NEP also maintained the existing national approach of price equalization and price protection for Canadians. A new blended price system was intended to combine the costs of different sources of oil (including cheap pre-1973 oil or "old oil", expensive non-conventional reserves and imports) into one weighted average price to consumers. Moreover, a Petroleum Compensation Charge (PCC) was to be levied on Canadian refiners to cover the costs of oil import compensation, thus guaranteeing an equalized price throughout the country. Although the price of oil to Canadian consumers was projected to rise at a steady rate, it was not to go above 85 percent of the international price. Figure 1-8 compares the resulting domestic wellhead prices with the cost of importing oil.

FIGURE 1-8 IMPORTED AND DOMESTIC CRUDE OIL PRICES, 1970-1984

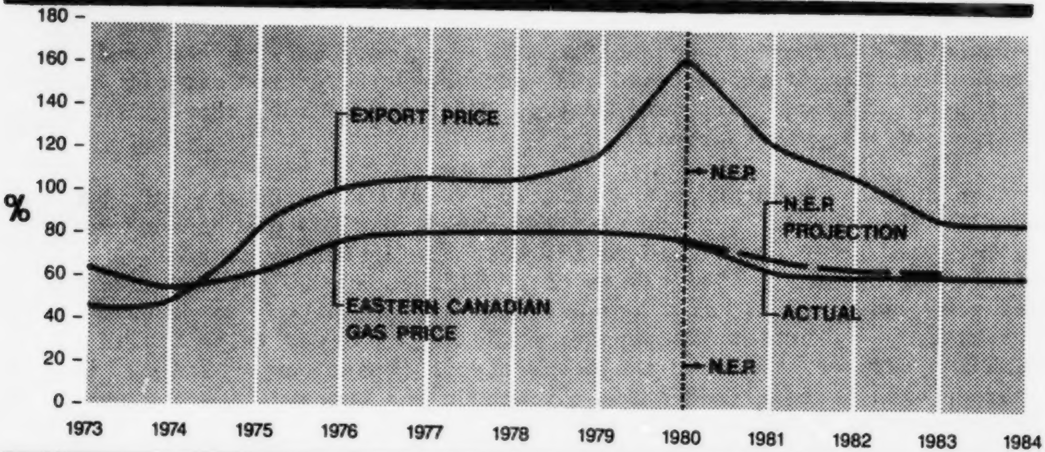


Source: Nova Scotia Department of Mines and Energy

Natural Gas Under the NEP

Under NEP policies, the domestic city-gate price of natural gas was allowed to drop slowly relative to the refinery gate price of crude oil to encourage the substitution of domestic gas for imported oil (see Figure 1-9). Additionally, city-gate prices were to be set at the same level in Toronto, Montreal, Quebec and Halifax to ensure the viability of an extended gas pipeline from Montreal to Halifax.

FIGURE 1-9 EASTERN CANADIAN AND EXPORT GAS PRICES AS A PERCENTAGE OF CANADIAN OIL PRICES, 1973-84



Source: The National Energy Program, 1980, pp. 32; prices after 1980 are projected at $1 Mcf = $5.803 bbl.
Nova Scotia Department of Mines and Energy

Energy as an Economic Engine

As an added benefit, the federal approach towards energy policy in 1980 also fitted neatly into the evolving economic policy of using megaprojects as a national engine of growth in the 1980s. According to the Major Capital Projects Inventory put out in October of 1981 by the Office of Industrial and Regional Benefits, $215 billion of a potential $256 billion (in $1980) required for major capital projects involved either the hydrocarbon/petrochemical or electrical generation/distribution sectors.

The Canada Lands Program of the NEP included a series of steps to ensure increased activity, especially by Canadian companies, in frontier areas and Canada Lands. This included the Petroleum Incentives Payment Program (PIP) of grants to encourage exploration by Canadian-controlled companies in these areas.

The Dangers with Projections

Unfortunately, no sooner was the National Energy Program in place than the premises regarding international supply/demand and pricing on which it was based began to crumble. Demand began to drop even before the measures proposed in the program took effect, and by 1983, Canada had again become a net exporter of crude oil. As the world price dropped, it became an unexpected ceiling on the domestic price and revenue assumptions altered dramatically.

Indeed, new patterns were already emerging when the National Energy Program, Update 1982 was produced. Although the strength or durability of the trends was not clear at the time, the NEP was introduced near the peak of oil demand, just before the peak of oil prices. The drop in both demand and price has since continued. In brief, events were outdating the NEP Update 1982.

The NEP Update 1982 did, however, address three new developments of importance to Nova Scotia. The first two, the signing of the Canada-Nova Scotia Offshore Resources Agreement and increased attention to coal as an indigenous energy source were already well-known to Nova Scotians. The third development was a growing concern with shut-in oil caused by falling domestic demand. Among the measures taken were increased export levels, largely of heavy crude to the United States for asphalt production, and the implementation of financial support programs to assist the movement of western crude oil to Atlantic Canada.

Partially as a result of the Domestic Transfer Compensation Program, foreign crude oil imports to Atlantic Canada dropped from 75 million barrels in 1982 to 35.5 million barrels in 1984. Between increased domestic receipts and reduced provincial oil consumption, domestic crude oil was supplying over 30 percent of Atlantic Canadian oil requirements in 1984, as opposed to none before the implementation of the program in 1982.

The NEP Update 1982 also addressed the growing surplus of natural gas which was clearly evident by 1982. Cumulative additions to natural gas reserves in Canada for the period 1976-80 were 29,400 trillion Btu, while cumulative production was only 12,300 trillion Btu. To remedy the resulting fall-off in natural gas exploration, the NEP Update 1982 announced a program to subsidize the cost of converting from oil to natural gas, and renewed support for the extension of the national gas pipeline to the Maritimes.

1982-1984

The trends towards lower oil demand, increasing world oil capacity, and dropping world prices which were emerging by the NEP Update 1982 continued over the next two years. By September 1984, when the National Energy Board (NEB) brought out a major report on Canadian supply and demand projections, the changed circumstances from 1979 were clearly addressed:

> The ten years that have elapsed since the first price shock can be divided into two distinct periods: a) the years between the first and second oil price shocks, 1973-1979, characterized by the dominance of world oil production and trade by the Organization of Petroleum Exporting Countries (OPEC); and b) the period from the second oil price shock to the present, characterized by a dramatic decline in world oil demand. (Canadian Energy Supply and Demand, 1983-2005, p. 6)

Box 1-2 and Figure 1-10 clearly indicate the degree to which the international stage had turned topsy-turvy between the two periods, and the very significant alteration required in energy planning premises.

Box 1-2

THE NATIONAL ENERGY PROGRAM, 1980

The world energy problem is a problem of oil availability and price. Over the past two decades, the world tripled its consumption of oil. The relative use of oil doubled from one-fifth to two-fifths of primary energy demand. This growth, coupled with a decline in the capacity of the United States to supply its own oil needs, has placed a heavy burden on world oil markets.

By the mid-1970s, the large multinational oil companies had lost their dominance over world oil production, and a new force emerged: the Organization of Petroleum Exporting Countries (OPEC), a cartel formed to obtain higher returns for its oil through supply management and decree. The cartel has succeeded. Oil prices that were $3 a barrel in 1960 — and still about $3 a barrel in 1970 — are now $38 or more. In addition, the traditional marketing and supply roles of the major oil companies are being substantially reduced by state-to-state deals between OPEC members and consuming countries. The seven major international oil companies, which handled 64 percent of non-communist oil production in 1973 and 1974, accounted for only 46 percent of production in 1979.

CANADIAN ENERGY SUPPLY AND DEMAND,
1983-2005
NATIONAL ENERGY BOARD, September, 1984

The net result of these developments was a sharp reversal in the trend of world oil demand. Between 1979 and 1983, oil consumption in industrial countries dropped by about 20 percent and remained virtually flat in developing nations.

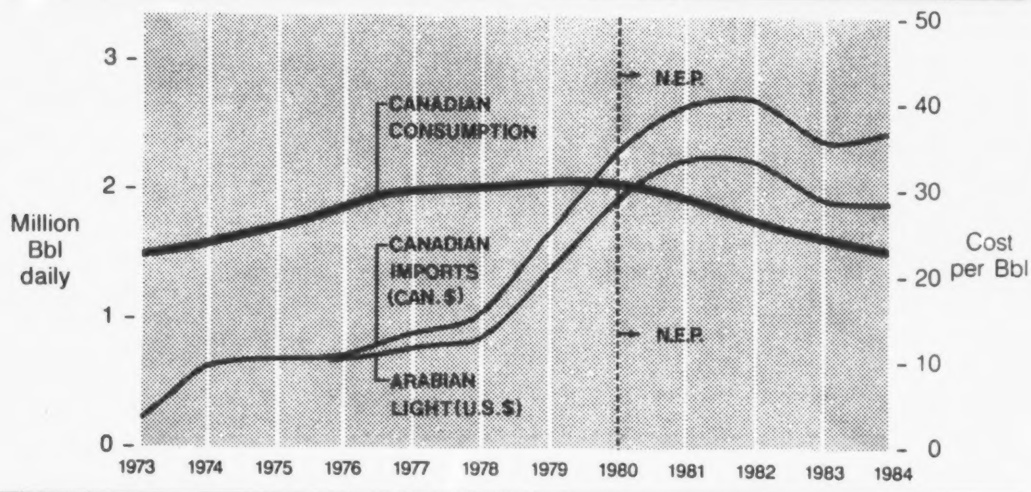
The structural and cyclical reduction in demand for petroleum which occurred led to a substantial change in the world energy mix in which oil in general, and OPEC oil in particular, steadily lost ground. OPEC's share of world oil trade was further reduced by the attempts of a number of non-OPEC oil exporters to capture an increasing share of a shrinking market. Betwen 1979 and 1983, OPEC production fell by some 40 percent, and by 1983 it represented only one-third of total world production, compared with over one-half in 1973. Over the same period, OPEC's share of world trade in oil declined some 60 percent from about 90 percent in 1973.

As a result of these changes, oil increasingly became the marginal fuel among all energy forms and OPEC the marginal supplier of the marginal fuel in the world energy markets...

. . .

Strongly influenced by the events of recent years, market observers have shifted the emphasis in their analyses of future oil prices to the demand side of the equation. Given the state of today's markets, it is hardly surprising that views on oil prices over the remainder of the decade tend to be conditioned more by expectations about the evolution of demand than of supply. [pp. 6-7]

FIGURE 1-10 OIL PRICES AND CANADIAN CONSUMPTION, 1973-1984



Source: BP Statistical Review of World Energy, June 1985, pps. 8, 12.
Nova Scotia Department of Mines and Energy

The Western Accord

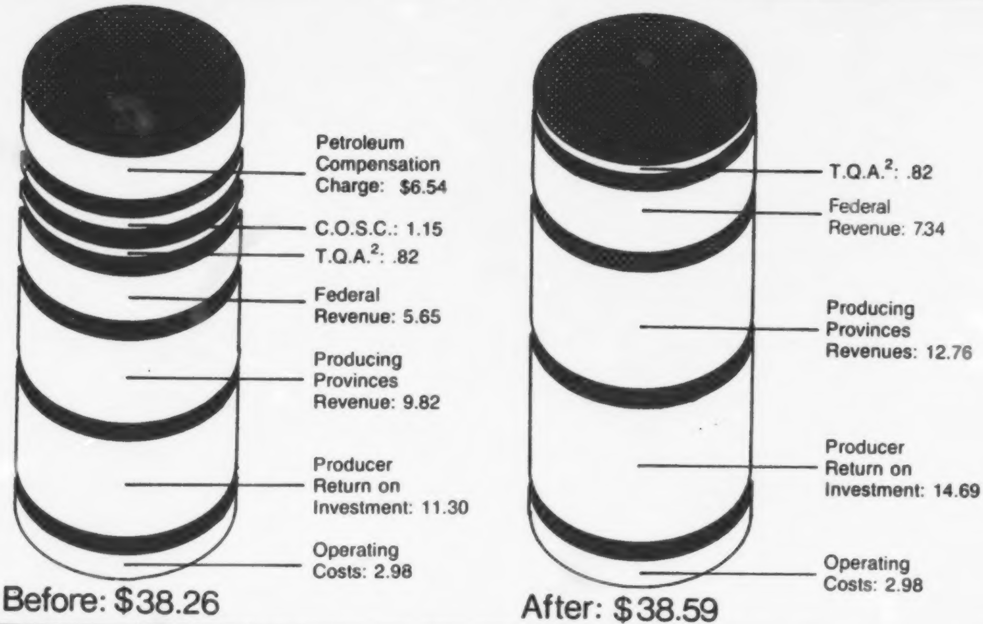
The major development at the national level in 1985 was the move towards deregulation or decontrol of oil and gas, typified by the Western Accord signed in March, 1985. As of June 1, 1985, crude oil could be purchased in Canada from Canadian or foreign sources at prices negotiated between the parties. Short-term export agreements (up to one year for light crude and petroleum products or two years for heavy crude) could also be entered into without prior NEB approval. Longer-term export contracts continued to be regulated as before.

Over-ride provisions exist if the federal government in consultation with the provinces ever decides that Canada's security of supply is threatened or that major disturbances in international pricing threaten Canadian interests.

Essentially, the Western Accord removed the difference between "old" (pre-1973) and "new" oil, and phased out various taxes specific to the petroleum industry. Figure 1-11 shows the Montreal refinery acquisition cost of Alberta "old" oil before and after deregulation.

With the termination of the Petroleum Incentive Payment Program, exploration and development within a province was placed on the same footing as that taking place offshore. In late 1985, a new tax credit of 25 percent of frontier exploration costs replaced PIP.

FIGURE 1-11 MONTREAL REFINERY ACQUISITION COST OF ALBERTA "OLD OIL" BEFORE AND AFTER DEREGULATION



Source: Nova Scotia Department of Mines and Energy

Note: T.Q.A.^{2} means Transportation and Quality Adjustment
COSC means Canadian Ownership Spread Charge

The cancellation of the Domestic Transfer Compensation Program, designed to promote a reduced use of imported oil in the Maritimes by subsidizing transportation costs for Canadian crude, was also a concern to Nova Scotia. Although the immediate result of this cancellation is not significant, in that imported oil is now no more expensive than domestic oil, the long-term implications could have a negative effect on Nova Scotia. Without the transportation subsidies, United States markets are likely to replace eastern Canada as a market for domestic oil. Once this occurs, it would prove far more difficult in the event of an international crisis or shortage to divert western crude oil to Atlantic Canada.

The Deregulation of Natural Gas Pricing

Since 1975, the domestic price of natural gas has been tied to the domestic crude oil price, with the city-gate price of natural gas at about 85 percent of the crude oil price until 1981, and 65 percent since then. The export price, or "border price" was also set by regulation until November 1, 1984, when a partial deregulation occurred. The new policy implemented in November 1984 freed export prices so long as they did not fall below the wholesale price of gas sold into the Toronto market (the Toronto city-gate price).

In February 1985, the National Energy Board estimated that gas exports would rise 17.5 percent in 1985, largely because of the new pricing policy. Indeed, some production companies forecast export gains of over 50 percent in 1985. Consequently, federal officials do not anticipate a drop in revenues as increased export volumes were expected to compensate for any fall in price.

The actual increase was approximately from 735 billion cubic feet in 1983-84 to 900 billion cubic feet in 1984-85, or just over 20 percent. However, federal projections suggested that under the existing price regime, exports could shrink to 650 billion cubic feet in 1985-86. Accordingly, the new policy brought into effect for the gas sales year commencing on November 1 1985, replaced the Toronto wholesale price floor with regional reference price criteria. The minimum export price will now be the price charged to Canadians in areas adjacent to the export point.

Decontrol Replaces Regulation

For over twenty years the Canadian energy sector has operated within a regulatory environment designed to stabilize and equalize prices throughout the country, and to protect both consumers and industry from the vagaries and extremes of the international market. The Western Accord appears to recognize that international oil politics and pricing have now become so volatile that not even our considerable indigenous energy resources would allow Canada to shelter itself without paying a substantial price.

The costs and benefits to the country, to the economic infrastructure and to the consumer have been weighed, deliberated and acted upon. The International Energy Agency (IEA), for example, has praised the decision to move to world prices, noting that low domestic energy prices are largely responsible for the fact that Canada's energy intensity has been rising for the past decade and is now second only to Luxembourg in relative energy inefficiency among IEA members (see Box 1-3).

The Canadian domestic price and the international price of oil were relatively close at the time of decontrol and this has reduced the immediate impact of the new approach. It may also have masked the extent to which the country must now learn to respond to the rapid changes which can occur in the international energy market.

Box 1-3

THE INTERNATIONAL ENERGY AGENCY

The International Energy Agency (IEA) was established in 1974 following the Arab oil embargo. Twenty-one countries have adhered to the Agreement on an International Energy Program, which created the IEA within the context of the Organization for Economic Cooperation and Development.

The policy body of the IEA is the Governing Board, which is based in Paris and meets regularly at the official level, and at least annually at the Ministerial level. The IEA plays a useful role as a spur to efforts by member countries, in addition to being a clearinghouse and centre for analyzing the international energy situation, outlook and measures to improve both.

Participating countries include Australia, Austria, Belgium, Canada, Denmark, West Germany, Greece, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom and the United States.

The basic objectives of the IEA are to:

- Promote secure oil supplies on reasonable and equitable terms
- Take common effective measures to meet oil supply emergencies
- Play a more active role in relation to the oil industry
- Reduce the dependence of members on imported oil by undertaking long-term cooperative efforts
- Promote cooperative relations with oil-producing countires and with other oil-consuming countries, including those of the developing world

It is not clear how long it will take the energy industry itself to adapt. Undoubtedly, a substantial portion of industry effort and employee expertise has been directed towards learning how to best operate within the complex regulatory environment. The same industry must now re-direct its attention to the competitive market, and a period of adjustment is undoubtedly inevitable.

Canada Remains a Net Exporter...

Overall, Canada is fortunate to be one of the few industrialized nations to be a net exporter of energy resources. Aside from Canada, only Norway, Great Britain, Australia and the Netherlands are net exporters among the Organization for Economic Cooperation and Development (OECD) countries.

...And a High Intensity Consumer

In 1984, Canada continued to be the highest per capita energy consuming nation in the world. Of all the industrialized countries, only the United States is close to Canada in the level of energy intensity whether the fossil-fuel or energy content conversion method is used (see Box 1-4 and Figure 1-12).

Perhaps the most interesting comparisons are with the Scandinavian countries, which have a much lower energy intensity than Canada despite similar climates. This indicates that population density and industrial structure are also important factors in energy intensity. For example, Canada is a major producer and exporter of aluminum, woodpulp, newsprint and petroleum fuels, all of which are energy-intensive products. The Scandinavian countries do not produce these products to the same extent.

Box 1-4

ENERGY INTENSITY AND FUEL CONVERSION

Measuring Canadian energy intensity and energy consumption per capita is complicated by the country's relatively high use of hydro for electrical generation, which can be misleading when converted from primary to end-use energy demand. If hydro energy is measured simply as the energy produced at the dam site, then it is converted as the energy content of the electricity produced, or 3,412 Btu per kWh. This works well in end-use energy tables and is called the energy output method.

However, although this is accurate in terms of showing the amount of energy actually produced and used, it creates difficulties in describing the relative importance of various energy sources. Since fossil fuels have an average efficiency of about 33 percent when used to generate electricity, about 10,000 Btu of fossil fuel energy must be used for each kWh hour of electricity.

Therefore, in describing the primary energy sources for an electricity generation system producing 20 kWh, 10 using hydro and 10 using coal, one would state that about 100,000 Btu of coal were used and only 34,120 Btu of hydro. This might make the reader think that 3 times as much electricity was produced using coal as using hydro power. A similar problem, though in lesser degree, occurs with nuclear power.

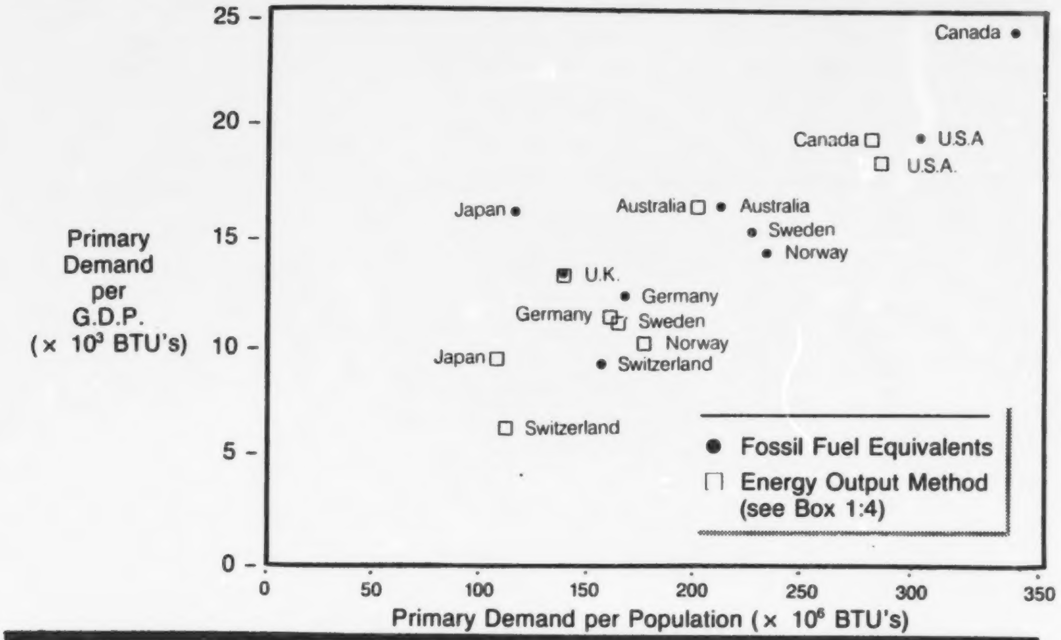
Therefore, when primary energy demand is being discussed, hydro and nuclear are often converted at about 10,000 Btu per kWh which is the fossil fuel equivalence method. Although it makes little difference in Nova Scotia where hydro power is not a major primary energy source, the potential difference in results is illustrated in the Table below, which shows the projected distribution of primary energy production in Canada by percentage fuel share (from the 1984 NEB Supply/Demand Report, p. 101):

	Fossil Fuel		Energy Output	
	1983	2005	1983	2005
Oil	30	20	37	37
Gas	22	19	27	28
Coal	10	13	13	18
Hydro	25	30	11	14
Nuclear	5	11	2	5
Other	8	7	10	10
TOTAL	100	100	100	100

Where the Country Stands

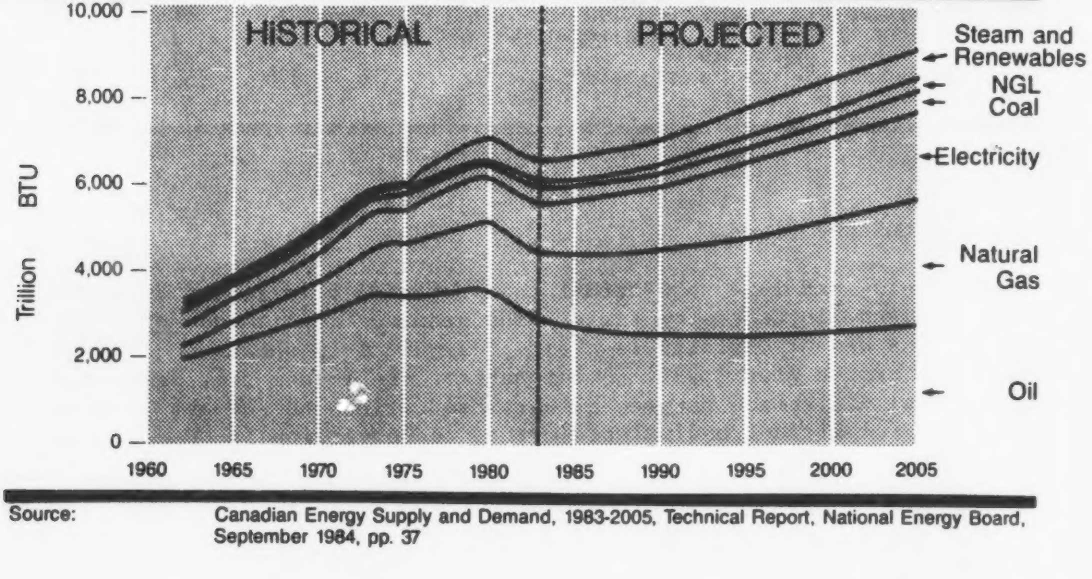
Figures 1-13 and 1-14 show actual and projected primary and end-use energy demand in Canada by fuel. The growing importance of both natural gas and electricity is clear. Figure 1-15 shows the energy flow for a sample year (1982) to demonstrate the losses that cause the significant difference between primary production and end-use demand when the fossil-fuel equivalence method of conversion is used (also see Box 1-5).

FIGURE 1-12 ENERGY INTENSITY OF SELECTED COUNTRIES



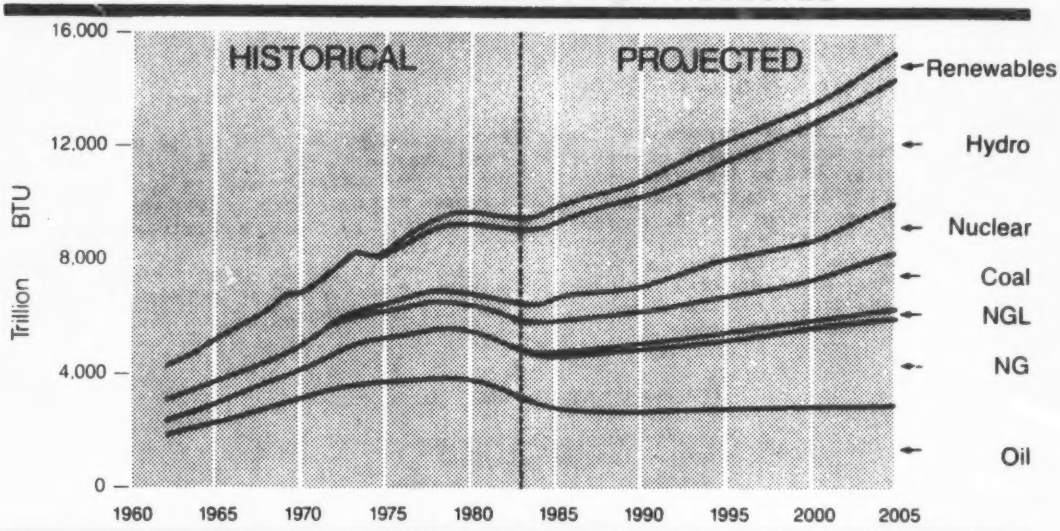
Source: Nova Scotia Department of Mines and Energy

FIGURE 1-13 CANADIAN END-USE ENERGY DEMAND BY FUEL: HISTORICAL AND PROJECTED



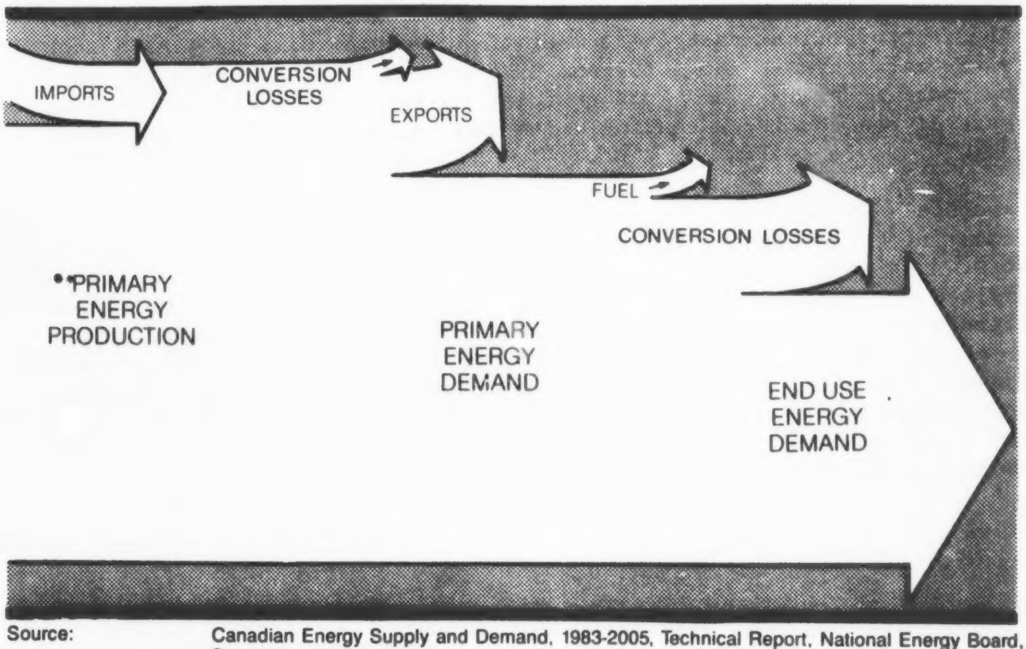
Source: Canadian Energy Supply and Demand, 1983-2005, Technical Report, National Energy Board, September 1984, pp. 37

FIGURE 1-14 CANADIAN PRIMARY ENERGY PRODUCTION BY FUEL: HISTORICAL AND PROJECTED



Source: Canadian Energy Supply and Demand, 1983-2005, Technical Report, National Energy Board, September 1984, pp. 103

FIGURE 1-15 CANADA: ENERGY FLOWS, 1982


IMPORTS
CONVERSION LOSSES
EXPORTS
FUEL
CONVERSION LOSSES
PRIMARY ENERGY PRODUCTION
PRIMARY ENERGY DEMAND
END USE ENERGY DEMAND

Source: Canadian Energy Supply and Demand, 1983-2005, Technical Report, National Energy Board, September 1984, pp. 97

Box 1-5

PRIMARY AND END-USE ENERGY DEMAND

Primary Energy Demand

Primary energy demand represents the total requirement for all uses of energy including energy used by the final consumer, intermediate uses of energy in transforming one energy form to another (eg. coal to electricity) and energy used by suppliers in providing energy to the market (eg. pipeline fuel). Primary energy is the total available energy content of a natural resource.

End-Use Energy Demand

End-use energy demand is energy used by final consumers for residential, commercial, industrial and transportation purposes and hydrocarbons used for such non-energy purposes as petrochemical feedstock. End-use energy is less than primary energy due to energy lost in the process of supply and in conversion from one fuel to another.

End-Use Energy Demand

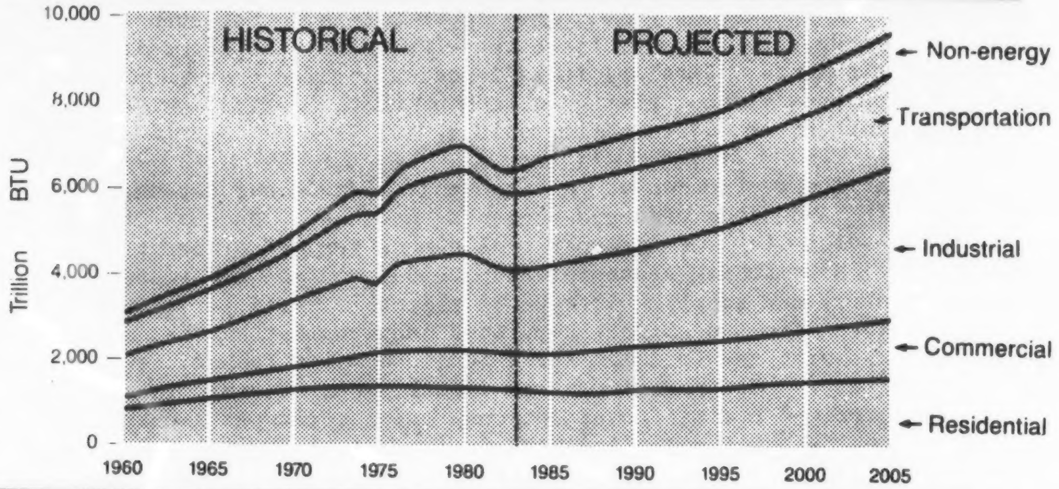
+ energy supply industry use
+ energy used to generate electricity and produce steam
+ other conversion losses
− electricity and steam demand

= Primary Energy Demand

Figure 1-16 shows forecast end-use by sector. The residential sector, which is driven largely by growth in the number of households and by real personal disposable income, grows relatively little. This reflects projections that the number of households will grow at a much slower rate than in the 1960s and 1970s, that real income will also grow more modestly, and that residential energy efficiency will increase as new housing, heating units and appliances replace existing stock.

Commercial energy use is likely to be slowed by a decline in the growth of educational and other institutions as population growth slows. This will be balanced by an average yearly growth in business services of approximately 2.5 percent. Industrial energy usage growth is projected to be in approximately the same range since improvements in energy efficiency significantly modify the effects of overall industrial growth. Energy use by the transportation sector will grow more slowly since improvements in the energy efficiency of passenger cars largely compensate for greater energy usage in truck, rail, air and marine transportation.

FIGURE 1-16 CANADA: END-USE ENERGY DEMAND BY SECTOR: HISTORICAL AND PROJECTED



Source: Canadian Energy Supply and Demand, 1983-2005, Summary Report, National Energy Board, September 1984, pp. 5

Finally, Table 1-2 shows Canadian reserves of oil and gas compared with total consumption over the past year and the past decade. While estimates vary considerably, this leaves Canada with under 10 years of reserves in oil and about 30 years of reserves in gas.

Table 1-2

CANADIAN OIL AND GAS RESERVES

	OIL Million of Barrels	GAS Tcf
1984 Consumption	530	2.6
Average 1975-1984 Consumption	628	3.0
Reserves	4,600	90.8

Source: National Energy Board
BP Statistical Review of World Energy, pp. 2,8,20,21

Summary

Canada is unusually fortunate in being both a net energy exporter and an industrialized country. Careful planning is essential to maximize the benefits which may be gained from these assets. Not even careful planning, however, can anticipate the effects of unexpected international developments. Finally, it is important not to overreact to any such developments without giving sufficient consideration to the long-term implications of sudden policy shifts.

The National Energy Program was an attempt to lessen our dependence on foreign oil and to expand our national options. Because of the unforeseen drop in the international demand for and price of oil, Canada has a breathing space in which to respond to the issues of energy security and supply. It appears that this brief period will be used to move from a highly regulated environment to a market-orientation, with the focus on short-term economics rather than long-term stability. Economic or market viability has become the basic criterion for the evaluation of options, with a reduced emphasis on conservation, substitution and the development of frontier or alternate energy resources. This approach holds dangers for Atlantic Canada and Nova Scotia since, until regional sources of gas and oil become available, we remain more vulnerable than the rest of Canada to the vagaries of international oil politics and pricing.

1.3 THE PROVINCIAL ENVIRONMENT

Background

The guiding principle on which Nova Scotia's 1979 Energy Plan was constructed is found in the following statement:

> The [Nova Scotia Energy] Planning Board recognized from the outset that the question of energy supply was not only an immediate problem but also presented an extraordinary opportunity for social and economic benefit to Nova Scotia. (Energy...A Plan for Nova Scotia, 1979, p. 4)

It is worth noting that this is remarkably similar to the conclusion reached by the federal government a full year later:

> [We believe] that energy should not be a problem. On the contrary, it can be a major factor in the solution to our broader challenges, if [we have] a program to provide [us] with energy security, the opportunity to participate in energy development, and fairness in the manner in which the benefits of [our] rich resources are shared. (NEP, p.22)

In its 1979 Energy Plan, Nova Scotia had already adopted a six point plan stressing security (a major effort in conservation in every sector of the economy; substitution for oil in every feasible way; ensuring against major disruptions in oil supplies); opportunity (bringing on indigenous energy supplies; developing Nova Scotia's own technical and business expertise to the maximum possible extent); and fairness (providing for close cooperation among neighbouring provinces and the nation generally in energy supply and distribution). Fairness was also addressed by the assurance that all areas of the province would share in the development of indigenous resources and technical expertise.

The National Energy Program and Nova Scotia

The areas in which the NEP was most relevant to Nova Scotia were where it coincided with the goals already set forth in the 1979 Energy Plan. These included conservation, oil substitution, and disengagement from the world oil market through the development of indigenous energy resources.

Because its main concern was with oil price and supply, the NEP quite explicitly did not deal in any detail with the issues of electricity generation or non-petroleum energy sources such as coal and nuclear power. This was because neither was seen as presenting the same national emergency situation as oil pricing and supply:

> For this reason, the National Energy Program acts decisively in those areas where we can wait no longer. It does not deal extensively with issues concerning the generation of electricity. These will be dealt with when the Government's nuclear power review is completed. Nor is the role of coal in Canada's energy system dealt with in great detail in this document. In many respects, coal provides Canada with a further measure of energy security ... Coal represents a development opportunity in Canada, and choices will have to be made as to how to best exploit this resource base... (NEP, p. 10)

The NEP, however, was looking at the situation in Canada as a whole; thus its disregard of electrical generation and of the implications of primary as opposed to end-use demand was not a major concern. However, because of the scarcity of hydro resources, these issues had more serious implications for Nova Scotia than any other province except Prince Edward Island.

Nova Scotia was an Anomoly in its Dependence on Imported Oil

In 1979, the most startling aspect of the supply/demand picture in Nova Scotia was the overwhelming reliance on oil as a primary and end-use energy source. The reason for this dependence on oil was simple: unlike many other Canadian provinces, Nova Scotia has no large-scale river hydro resources and no access to domestic natural gas. In 1979, eastern Quebec and the other Atlantic provinces shared Nova Scotia's lack of access to western gas, but only Prince Edward Island shared Nova Scotia's lack of developable hydro resources.

Demand was More Consistent with National Patterns

Although Nova Scotia was in an anomolous position with respect to supply, provincial energy demand did not depart dramatically from the Canadian average in total demand, or in distribution of end-use energy by sector. Although total energy use per capita was below the national average, and the percentages used by the transportation and industrial sectors were respectively somewhat higher and lower, this was consistent with climatic, geographic and economic conditions. Transportation use, for example, is affected by the substantial fuel needs of the fishing industry and by a comparatively low reliance on public transit systems because of a less urbanized society than the Canadian average.

The Objectives of the 1979 Energy Plan

The 1979 Energy Plan listed six objectives:

1. Mount a major effort in conservation in every sector of the economy: residential, commercial, industrial and transportation.
2. Substitute for oil in every feasible way.
3. Bring on indigenous energy supplies: oil and gas, coal, river and tidal hydro, biomass (including wood), wind and solar.
4. Develop Nova Scotia's own technical and business expertise to the maximum possible extent.
5. Ensure against major disruptions in energy supplies.
6. Provide for close cooperation among neighbouring provinces and the nation generally in energy supply and distribution.

A seventh objective, which was implicit in the very publication of the 1979 Energy Plan, was raising the awareness of the public, institutions and even government to the importance of energy issues and planning. This implicit objective also encompassed a number of recommendations designed to enhance the province's research capacity and to broaden the general knowledge base on which planning decisions could be based.

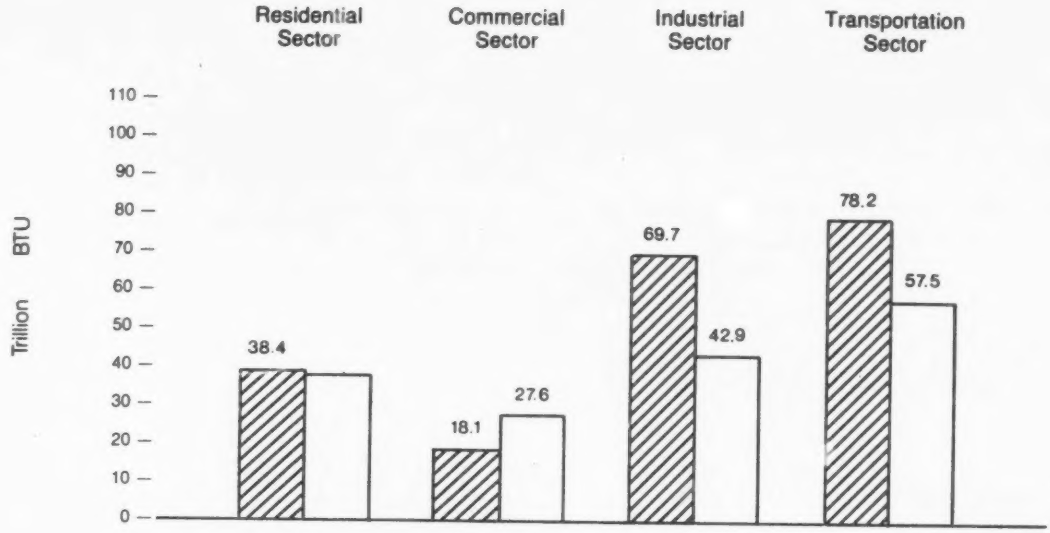
Conservation

The 1979 Energy Plan projected both a base case scenario which could be expected if no action were taken, and a conservation case scenario, which could be anticipated if serious conservation programs were undertaken. Recommendations on measures that would assist in meeting the conservation target case were made in the residential, commercial/institutional/industrial and transportation sectors. In all three, substantial progress has been made towards implementation.

The major thrust of the recommendations was information programs, including energy audits and pilot projects. The essential philosophy behind both approaches was that, Nova Scotians, given access to the facts and the necessary resources to implement their decisions, would realize the individual and societal benefits of conservation and act appropriately and decisively.

Consequently, from 1979 to 1983, energy consumption continued to decline as conservation measures and programs took effect. In 1984, Nova Scotia experienced its first rise in primary energy use since 1979, but the increase was only a fraction of one percent and more than accounted for by economic growth. By way of illustrating the major conservation effort that occurred, Figure 1-17 shows actual energy use in 1982 and 1984 by sector, as compared to the 1979 projections.

FIGURE 1-17 1979 ENERGY PLAN: END-USE ENERGY PROJECTIONS COMPARED TO ACTUAL (1984)



Source: Nova Scotia Department of Mines and Energy

▨ Forecast ☐ Actual

Although it is difficult to distinguish the exact impact of these conservation initiatives from the effects of energy pricing and economic trends, the fact that the province experienced such gains in energy efficiency during a period of overall economic growth argues strongly that implementing the 1979 recommendations had a significant effect.

Oil Substitution

Although the 1979 Energy Plan placed considerable emphasis on conservation measures that could reduce end-use demand, the single most significant thrust of the document was in its approach to the supply of energy. The essential concern of the drafters of the 1979 Energy Plan was Nova Scotia's dependence on imported oil and the disastrous fiscal impact.

It now appears that neither oil prices nor demand are likely to rise as rapidly as projected. Nonetheless, the Nova Scotian projections of 1979 were entirely consistent with the federal projections in the NEP a year later. And although concerns about oil prices and security of supply have receded in the past few years, they could as easily reemerge given a few untimely international events. The context of 1979 could readily become the context of 1986 or 1987.

In any event, the question is one of quantity and not of essence. With the exception of Prince Edward Island, Nova Scotia was the province most dependent on foreign oil. In 1979, oil accounted for 74 percent of residential energy use, 34 percent of commercial energy use, 77 percent of industrial energy use and all of the energy used in the transportation sector. Overall, 70 percent of Nova Scotia's end-use energy requirements were supplied by petroleum products and over 76 percent of its primary energy consumption required imported oil.

Direct oil use is relatively inelastic in the short term. Capital stock in most sectors turns over fairly slowly, and fuel substitution normally requires new capital stock. Cars designed to run on oil will not easily convert to other fuels. Homeowners with oil furnaces will be reluctant to buy new furnaces while their old ones still work. The one area in which it was expedient and realistically possible to make a substantial immediate impact on oil imports was electrical generation.

Given the situation with respect to rising oil prices and concerns about security of supply, the 1979 Energy Plan strongly recommended that the electrical system revert to coal as its primary fuel as rapidly as possible. International oil price forecasts, and more particularly, the problems of security of supply were such that it appeared worthwhile to bring new coal-fired units into production somewhat before they were required for capacity reasons. This measure had the additional benefits of using an indigenous fuel and of retaining the economic benefits of energy production within the province.

As a result, the Nova Scotia Power Corporation has constructed four 150 megawatt coal-fired generating plants which have dramatically reduced the Corporation's dependence on heavy fuel oil. By 1984, oil accounted for only 13 percent of the province's electrical generation, as opposed to over 65 percent in 1979.

The other major recommendation relating to oil substitution was that:

> "... the Province of Nova Scotia should support the extension of the natural gas pipeline system to carry Canadian natural gas to Nova Scotia as a substitute for a portion of its current crude oil requirements, and should press for the earliest possible start of construction". (Energy...A Plan for Nova Scotia, 1979, p.247)

Nova Scotia was a strong supporter of the application by Trans-Quebec and Maritimes (TQ&M) to extend the trans-Canada pipeline from Montreal to Halifax. The province intervened in favour of the project during the NEB hearings which took place during 1980-81. Since this recommendation was made, however, the Nova Scotia situation with respect to natural gas has changed dramatically due to continuing offshore discoveries. One side-effect of this was a realigning of federal priorities with respect to extending the natural gas pipeline system.

With the discovery of developable quantities of natural gas offshore Nova Scotia, the federal government called into question the necessity of connecting the Maritime region to western natural gas supplies. The emphasis is now placed instead on encouraging the earliest possible development of offshore gas reserves. In 1982, it was decided to complete only the engineering and survey work of the proposed pipeline until the delineation of gas reserves in the offshore had been completed, and even this has since been put into abeyance pending offshore developments.

Although the delays in the arrival of natural gas significantly affected the 1979 projections for reducing oil dependency, great strides were made towards reducing oil imports through coal substitution. In 1984, 27 percent of Nova Scotia's primary energy needs were fulfilled by coal as opposed to only 16 percent in 1979. Oil consumption was down more than one-quarter in absolute terms, and its share of total primary energy consumption dropped from 76 percent to 64 percent. It is worth noting that if natural gas and propane supply had developed as projected, oil's relative share of the total consumption would almost exactly match the 1979 conservation case projections.

Developing Indigenous Energy Supplies

Although the emphasis in the 1979 Energy Plan was on the issue of substitution of coal for oil, especially with respect to electrical generation, the report also dealt in general terms with the status of all possible sources of energy, including coal, oil and gas, peat, uranium, river hydro, tidal hydro, biomass, solar, wind and geothermal.

The 1979 Energy Plan made extensive recommendations about delineating coal reserves and filing the information in an accessible and retrievable form. All have been or are being implemented. The expansion at Lingan Mine was completed, and the rehabilitation of No. 26 was under way when it was shut down by a disastrous fire in 1984. Development of the Prince Mine has continued and, in 1984, was up to an operating level of approximately one million tons per year. The Point Aconi surface mine was opened, and overall coal production capacity increased to almost four million tons by 1984.

Following the signing of the Canada-Nova Scotia Agreement on Offshore Oil and Gas Resource Management and Revenue-Sharing in early 1982, the level of offshore oil and gas exploration dramatically increased with the drilling of approximately 30 new exploration wells up to the end of 1984. An application has been made to the National Energy Board for approval to export Venture gas assuming a start date of 1990. Discovered reserves in the Sable Island area had reached approximately four trillion cubic feet in 1985.

The Annapolis Project was undertaken as recommended. It is now complete and was officially opened in August, 1984. Feasibility studies conducted by the Tidal Power Corporation in 1981-82 and 1984-85 confirmed the viability of a full-scale tidal project. The remaining river hydro potential in the province is under frequent review and two new units have been constructed pursuant to the 1979 Energy Plan recommendations.

As recommended, major studies have been carried out on the feasibility of wood chip substitution, confirming that this is a major potential energy resource. Nova Scotia's peat reserves have also been evaluated with promising results, and several studies have also taken place with respect to utilizing municipal and agricultural wastes.

The Small Scale Energy Demonstration Program, which offered assistance to about 300 renewable and innovative energy conservation projects between 1980 and 1983, caused considerable research into the practical application of various techniques to Nova Scotian conditions. Generally speaking, the results indicated that the usefulness of geothermal technology has limited applications in the province, that wind energy was most practical when utilized in small-scale projects remote from regular energy sources, and that solar energy had promising, although limited, application. Currently, there are approximately 500 residential solar hot water systems in the province, as well as about 50 privately-owned wind turbines.

Overall, the province is moving towards information programs in these areas and away from grants. Demonstrations will continue to play a role in introducing new technologies and overcoming perceived technical risk. Renewable energy now supplies approximately 4.7 percent of total provincial primary energy consumption, up from 2 percent in 1979. Much of this was a result of increased wood-burning, and there is good reason for the province to concentrate its future efforts with respect to renewable resources in the area of wood-chip use. Results from demonstration projects and studies to date have been almost uniformly positive, and there are considerable resources available.

Developing Provincial Expertise

There have been three main aspects to the development of provincial energy expertise. The first was the enhancement of research and development programs both in the private sector and in government so as to ensure that Nova Scotia remains abreast of relevant new energy technologies. The second was the development of training programs to ensure that Nova Scotians can fill new energy-related jobs as they become available, especially with respect to offshore gas production and coal mining. The third was the negotiation of administrative and legislative agreements with the federal government to ensure that Nova Scotian business benefits as much as possible from energy-related projects, both through economic participation and technology transfer.

The first policy effort essentially responded to the research and development recommendations of the 1979 Energy Plan. Since 1979, Nova Scotia has both stimulated and improved the coordination of energy research and development within the province. However, given the magnitude and cost of the international energy research and development effort, Nova Scotia has been very careful not to duplicate work being done elsewhere. In many areas such as conservation and biomass, it is more appropriate for Nova Scotia to demonstrate technological improvements than to support basic research to develop those improvements. However, in certain areas such as coal and tidal power, the province has had to stimulate basic research into issues specific to our particular conditions.

The second thrust centered around manpower training recommendations with respect to both coal and offshore gas production and distribution. Subsequent to the 1979 Energy Plan, two consulting projects were undertaken on behalf of the Department of Mines and Energy to assess the training requirements and manpower demands of offshore gas development. The first (the Thorne, Stevenson and Kellogg et al or TSK study, 1980) dealt with facilities in the offshore region during both the construction and production phases. The second (the DPA study, 1982) analyzed the labour and training requirements for onshore facilities during both the construction and operation phases. The studies identified specific occupations for which programs will need to be developed. They also recommended that a cautious approach be taken to monitoring manpower supply/demand to ensure that the available training is coordinated with project scheduling.

As its third thrust in developing Nova Scotia expertise, the 1979 Energy Plan recommended a study of the spin-off effects of becoming a producer of oil and natural gas. Both the TSK and DPA studies also dealt with a wide range of potential impacts on the province, including manufacturing requirements, service industry expansion, and business opportunities.

As a result of the Canada-Nova Scotia Agreement on Offshore Resource Management signed in early 1982, oil companies must explain the benefits accruing to Nova Scotia businesses, as well as to Canada, before receiving an exploration or development permit. During 1984, almost 2,500 persons were employed in the offshore and Nova Scotians constituted 72 percent of the workforce. Put another way, offshore activities in 1984 accounted for approximately $400 million in direct spending, and added over 2 percent to the province's Gross Domestic Product (GDP).

Additionally, many of the demonstration projects on alternative technologies funded under the Canada-Nova Scotia Energy Conservation Sub-Agreement have involved local firms attempting to build a market in alternative technologies. Overall, the private sector has become much more aware of the possibilities involved in the local development of such technologies, although the fact that most of the firms are small and the market diffused throughout the province makes the impact difficult to assess.

Ensuring Secure Supplies

The substitution of coal for oil was, of course, one way in which the 1979 Energy Plan ensured a greater security of supply. However, a very large concern continued to exist: in the event of an international crisis, Atlantic Canada would lose its access to imported oil. The 1979 Energy Plan recommended at numerous points that the federal government engage in emergency planning to ensure that, in the event of an international disruption, western Canadian oil would be available to eastern Canadians.

The Province of Nova Scotia has continually reiterated to the federal government the vulnerability of the Atlantic region to any interruption in foreign crude supplies. This point continues to be raised before such federal/provincial gatherings as the Provincial Advisory Committee to the Energy Supplies Allocation Board (ESAB) and the Interprovincial Advisory Committee on Energy (IPACE). In addition, this situation is restated in provincial submissions to the National Energy Board and the federal Department of Energy, Mines and Resources.

The other provinces of Canada, through IPACE, have joined in recommendations to the federal government on supplying eastern Canada with western crude during an emergency. The recommended measures include extending the Inter-Provincial Pipeline to eastern Canada from Montreal, reversing the Portland Pipeline and arranging a definitive swap arrangement with the United States in any emergency.

Although the federal government has done considerable work on detailed allocation plans, their position on ensuring the necessary transportation links continues to be that workable arrangements can and will be made at the time of an emergency. Nonetheless, the province remains concerned that the Energy Supplies Allocation Act is not sufficient to guarantee that an oil shortage in Canada would be distributed equally throughout the regions of the country.

Finally, the Nova Scotia Power Corporation has done considerable work in developing emergency plans for electricity rationing. A report prepared in 1981, entitled "Procedures to Counteract Possible Oil Supply Shortfalls", considered such measures as voluntary demand reduction, mandated demand reductions, street lighting rationing, voltage reductions, and the discontinuance of interruptible services.

Providing for Energy Cooperation

The 1979 Energy Plan recommended "an all-out effort to establish a regional power pool ...", and called for Nova Scotia to take the lead in developing a regional plan that would enable the province to obtain a substantial amount of power from a Maritime Power Pool.

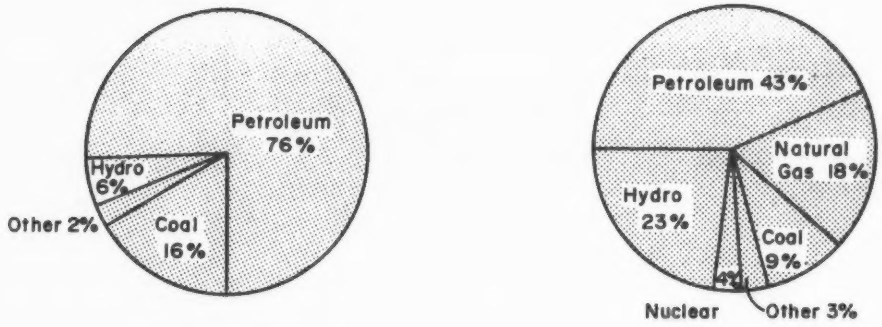
Unfortunately, despite the best efforts on Nova Scotia's part, the Maritime Energy Corporation was set aside in 1980. Rather than rely on outside sources to ensure base demand, the Nova Scotia Power Corporation had to implement a "go-it-alone" plan. However, the Coordinating Committee of Maritime Electric Utilities (CCMEU) was formed to facilitate regional cooperation. Significant cost savings to the Maritime region, estimated at $27 million in 1983, are being made through planning coordination and power sharing.

Where the Province Stands

Figure 1-18 shows the difference between 1979 and 1984 in the various primary energy sources as percentages of total provincial consumption. The success in substituting coal for oil is clear, although note should also be taken of the major gains made in utilizing renewable resources. It also shows the same information for Canada as a whole in 1979 and 1984. Despite the gains the province has already made, Nova Scotia's dependence on imported oil remains far higher than the national average.

FIGURE I-18 : PRIMARY ENERGY CONSUMPTION BY FUEL NOVA SCOTIA AND CANADA, 1979 AND 1984

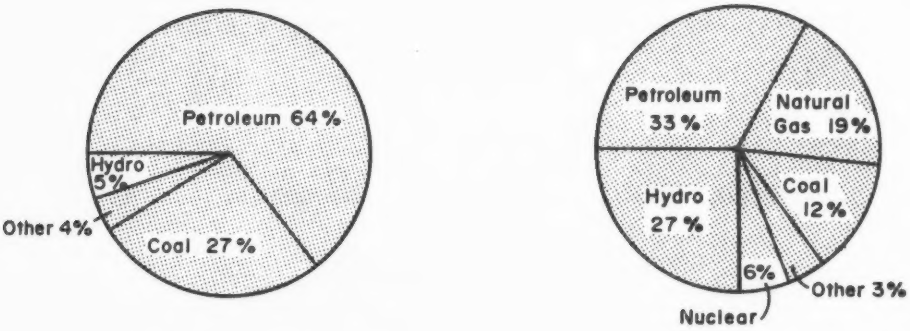
1979



NOVA SCOTIA

CANADA

1984



NOVA SCOTIA

CANADA

Note: Petroleum includes natural gas liquids
Source: Energy Information Handbook; EMR

Table 1-3 shows end-use energy consumption within the province by energy source for 1979 and 1984. Although coal-powered electricity has made significant gains, the dependence on petroleum products is still a matter of concern.

Table 1-3

END-USE ENERGY CONSUMPTION BY FUEL, NOVA SCOTIA
(trillion Btu)

	1979	%	1984	%
Coal and Coke	17.4	8.7	6.0	3.6
Electricity	21.2	10.6	23.4	14.1
Steam	16.6	8.3	8.1	4.9
Wood	4.9	2.5	10.9	6.6
Refined Petroleum Products	139.5	69.9	117.4	70.7
TOTAL	199.6	100.0	165.8	100.0

Source: Nova Scotia Department of Mines and Energy

Table 1-4 compares Nova Scotia's end-use energy intensity to that of Canada as a whole in 1979 and 1984, using both the amount of energy consumed per capita and the amount per dollar of GDP. Nova Scotia has obviously been very successful in increasing energy efficiency.

Table 1-4

ENERGY INTENSITY, NOVA SCOTIA AND CANADA
1979 and 1984

	Per capita (million Btu)			Per (1981)$GDP (thousand Btu)		
	1979	1984	Change	1979	1984	Change
Nova Scotia	237	192	-19%	25.7	19.4	-24%
Canada	258	227	-12%	18.1	16.0	-12%

Source: Nova Scotia Department of Mines and Energy

1.4 CONCLUSION

International energy dynamics have changed dramatically since 1979, with the primary fear now being an uncontrolled drop in oil prices rather than continuing price increases. As world energy consumption fell, and new oil fields commenced production, an oversupply of oil developed and OPEC's share of the market dropped dramatically. Together with falling prices, this situation caused concerns about security of supply to recede into the background of energy planning. The international energy environment is still unstable and potentially volatile, but relatively little attention is being paid to the implications of re-emerging oil shortages in the 1990s and a renewed long-term dependence on OPEC (and particularly Middle East) reserves.

National and provincial energy planning must be developed in light of the best existing projections of long-term international trends. They must also be sufficiently flexible to respond to the unexpected developments which inevitably occur. The new federal approach recognizes that the country cannot remain fully insulated from international energy dynamics and the volatility of international pricing.

The effects of decontrol are still uncertain. It is clear, however, that with the national policy now emphasizing market conditions rather than conservation, substitution and the development of frontier resources, Nova Scotia is left with little protection against its unique dependence on foreign oil.

In 1979 and 1980, the international environment was such that Nova Scotia and the federal government had essentially the same priorities in energy planning. Consequently, the 1979 Energy Plan foreshadowed many of the basic initiatives in the National Energy Program. The situation in 1985 is not the same, and Nova Scotia's priorities are now somewhat different than Canada's. Nova Scotia's traditional dependence on imported oil means that a deregulated environment may have different impacts on the province than on the country as whole.

Notwithstanding changing international conditions, Nova Scotia has successfully implemented the majority of the 1979 Energy Plan recommendations with positive effects on the level of provincial energy consumption and on the provincial economy. The basic thrusts of the 1979 Energy Plan remain valid in 1985: conservation; oil substitution; the development of indigenous resources; the maximization of economic benefits to the province; security of supply; and close cooperation with both neighbouring provinces and the federal government to ensure efficient and equitable energy supply and distribution. Regardless of national policies, these remain Nova Scotia's priorities. They can be summed up as two basic themes: **energy stability and economic development.**

Energy stability is critical to both government and private sector planning. In Nova Scotia, it can best be achieved by diversifying and expanding the province's energy mix to reduce petroleum dependence and bring it in line with the national average. Energy stability can also be assisted, however, by continuity in energy planning. Although the 1979 Energy Plan was influenced by existing international conditions, it was largely based on Nova Scotia's historical energy position and long-term forecasts respecting oil pricing and supply. Neither have substantially changed. There is no reason for the province to "change horses in mid-stream", and considerable danger inherent in such a course. Energy resources are rarely developed quickly, and are developed optimally in an environment of long-term policy stability. There is a strong possibility that the conditions existing in 1979 and 1980 could re-emerge by the 1990s, a very short time in the world of energy resource development.

Energy stability also requires the flexibility to adjust energy policies in light of changing international and national situations. In short, it requires both information and a diversity of energy resources. Nova Scotia has learned much from the information and research initiatives undertaken as a result of the 1979 Energy Plan, at both the level of governmental department and individual citizen. Information initiatives must be continued. An informed government and an informed populace is the best guarantee of a rational and effective response to changing circumstances.

Diversity requires the development of the full energy mosaic, including both alternative energy resources and conservation. The risk associated with traditional "supply expansion" megaprojects must be balanced by promotion of "demand reduction" initiatives. Efforts must be made to improve the workings of the energy marketplace by enhancing competition between resources and between suppliers of those resources.

Energy stability for Nova Scotia means continuing the policies of substituting indigenous resources for imported oil and encouraging conservation. These lead in turn to the other major theme: economic **development**. The 1979 Energy Plan clearly recognized the potential of energy resource development as an engine for economic development. Between 1979 and 1985 Nova Scotia, with major programs in both coal development and offshore gas exploration, was probably more successful than any other part of Canada in developing that potential.

Energy supply projects are, however, more labour-intensive and economically beneficial in the development than in the production phase. This is an inherently limiting factor in their use as economic development policy tools, and export potential must be realized and enhanced to turn energy supply projects into long-term economic development resources.

Export is the first sub-theme that emerges in energy development, and is important to all energy development projects -- whether coal, offshore gas or tidal power.

The second sub-theme of economic development is **appropriateness**. There are numerous energy resources available in Nova Scotia which might not be appropriate to develop in a province that had a different energy mosaic (massive hydro-electric potential, for example). It may also be appropriate to develop certain energy resources in some areas of the province and not in others that already have easy low-cost access to more traditional energy sources.

Peat is an example of an indigenous, labour-intensive energy resource that is most economically viable within a limited radius of its production location. Since it is a resource largely located in non-urban areas where both energy costs and unemployment are relatively high, its development could have a net benefit both to the locality and to the province.

The third sub-theme is the **continuing economic spin-offs of increased energy efficiency**. This has gradually emerged as a major benefit of conservation policies. A report distributed by Canertech Inc. in 1983, for example, analyzed Statistics Canada's input/output table to discover that the job creation ratio of energy conservation was almost twice that of energy supply. In fact, between three and four times as many jobs were directly created by energy conservation as energy supply.

This is consistent with the results of the Nova Scotia conservation programs. The Pilot Projects resulted in the emergence of a number of small business specializing in alternative energy technology, and the retrofit and information programs appear to have created a small boom in the renovation industry. The apparent conclusion that conservation programs lead to the development of small business is entirely consistent with the province's economic development policies.

In brief, Nova Scotia has had an enviable degree of success in the implementation of its 1979 Energy Plan. The preferred alternative is to maintain a consistent path in energy policy, emphasizing the development of indigenous resources and increased energy efficiency, appropriately modified to meet the difficulties and challenges presented by the mid-1980s.

Part 2.

The Province's Resources

2. THE PROVINCES'S RESOURCES

2.0 INTRODUCTION

Provincial influence over energy policy arises mainly in the areas of the energy mix, the interaction between energy consumption/production and overall economic growth. Exercise of this influence requires a thorough knowledge of indigenous energy resource potential and expected energy demand, as well as the possibilities of increasing energy efficiency. Essentially, energy planning assesses energy resources and demand, analyzes the implications of the relationship between the two, and recommends ways to minimize predictable difficulties and maximize potential benefits by modifying either demand requirements or supply possibilities.

This part of **Energy Plan, 1985** addresses three elements essential to energy planning for Nova Scotia:

(1) the province's natural resources

(2) the potential for energy management and increased energy efficiency

(3) the provincial energy model and forecasts of energy demand

The first section, **Natural Resources**, describes all indigenous energy resources in order of magnitude, including resources presently used (coal, river hydro, tidal power, wood), resources of potential importance (offshore oil and gas, peat, municipal wastes), and resources which are still experimental in nature or marginal in the foreseeable future (onshore petroleum and oil shales, solar, wind, agricultural waste). Non-indigenous sources (e.g. imported oil) and end-use energy forms such as refined petroleum products and electricity are also reviewed.

The second section, **Energy Efficiency**, discusses the potential of improved energy management (conservation). Energy management improvement is increasingly recognized as equivalent to an energy resource. A unit of energy saved is a unit of energy which does not have to be produced or imported. Moreover, the economic spin-offs of energy efficiency are significant in terms of increased employment and economic activity, and tend to be evenly distributed throughout the province.

The third section, **The Status Quo Case**, describes Nova Scotia's energy forecasting models and the result of the **status** quo projections to the year 2005 for both end-use and primary fuels. **The status** quo case assumes that no new energy initiatives are undertaken.

2.1 NATURAL RESOURCES

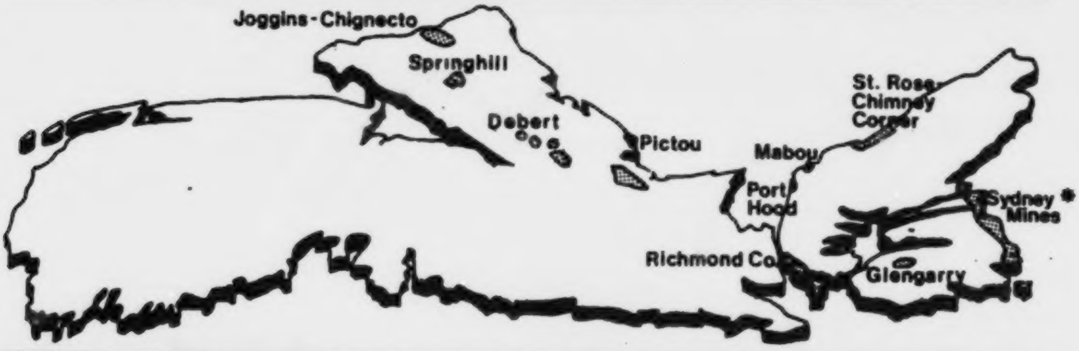
Coal

The 1979 Energy Plan estimated that the province had 3.5 billion tons of coal in situ, including submarine reserves (in situ simply refers to coal in its natural location). Nova Scotia's recoverable reserves (or coal that can reasonably be extracted by mining) were estimated at one billion tons in 1979. By 1984, coal accounted for 26.8 percent of primary energy demand in Nova Scotia.

The 1979 Energy Plan identified all provincial coal seams, highlighting areas of immediate interest and providing data on the properties of the various seams. Considerable work has been done since then, but the best estimate of recoverable reserves remains at approximately one billion tons. Appendix A provides an update of the coal seam properties originally provided in the 1979 Plan.

Although there are a number of small reserves throughout the province (see Figure 2-1), the vast majority of remaining in situ reserves are in the Sydney Coalfield. The majority of commercially recoverable coal and most existing production takes place in this area.

FIGURE 2-1 MAJOR COALFIELDS IN NOVA SCOTIA



* The Eastern Cape Breton coalfields extend to the northeast under the Atlantic Ocean.
Source: Nova Scotia Department of Mines and Energy

In its natural state, coal is most adaptable to large-scale applications such as the generation of electricity, and to use in certain energy-intensive industries. This is largely because coal storage and transportation require sophisticated handling equipment which can only be justified if large volumes of coal are being used. Because of handling costs, coal is often used close to the point of production. Electrical generating facilities, for example, can be located in the vicinity of coal mines.

The chemical and physical properties of coal can critically affect its marketability (see Box 2-1). Nova Scotian coal tends to be high in sulphur content which limits a large percentage of present production to use as thermal coal. The bulk of the demand for Nova Scotian thermal coal comes from the domestic generation of electrical energy. Metallurgical coal is largely exported.

Box 2-1

COAL PROPERTIES

Nova Scotia coal is typically bituminous, which is a 'soft' coal as opposed to anthracite, but a 'harder' coal with a higher thermal content than lignite. Generally, bituminous coal is considered to be a low ash, low moisture coal with a heat content, or calorific value, of over 11,000 Btu/lb.

Ash and sulphur content are also important in determining the potential use and price of coal. Thermal coal, for which the ash and sulphur criteria are relatively undemanding, is simply coal used to produce heat although the term is often synonomous with coal used for electrical or steam generation.

Metallurgical quality coal is required to produce coke for steel manufacture. It must be low in ash and sulphur and have good coking properties. Often, it is a blend of two bituminous coals. It commands a higher price than thermal coal, and is generally more popular in export markets.

From 1960 to 1973, annual raw coal output in Nova Scotia declined from 4.6 million tons to 1.2 million tons, largely because of the availability and low price of oil. After the first oil price hike in 1973, coal production rose gradually but steadily to almost 3 million tons in 1979. Since 1979, the use of coal for electrical generation has doubled. The closure of No. 26 mine by a fire in 1984 resulted in a temporary setback, reflected particularly in lower production and exports of metallurgical coal.

There are at present six companies producing coal in Nova Scotia, including one involved in mine dump reclamation (recovering the useable coal from the tailings or "dumps" of previous mining activities).

The largest producer by far is the Cape Breton Development Corporation (CBDC) which operates the Lingan and Prince mines and also operated the No. 26 mine until it was closed by fire.

Table 2-1

NOVA SCOTIA RAW COAL OUTPUT BY MINE
1980 and 1984
(short tons)

Company	Mine	1980*	1984
CBDC	Lingan "A"	221,317	0
	Lingan	1,601,744	2,089,256
	Prince	241,198	1,064,999
	No. 26**	1,101,218	318,831
	Recovered Wash Plant Rejects	394	0
CBDC Sub-total		3,165,871	3,473,086
Novaco	Point Aconi	52,349	153,533
Brogan	Brogan	75,713	50,203
Pioneer	Drummond	12,919	35,027
Evans	Evans	45,636	50,941
Selminco	Dump reclamation	35,601	137,716
Other		55,894	4,486
TOTAL (raw coal)		3,443,983	3,904,992
LESS waste and inventory adjustments		455,770	801,433
TOTAL SALEABLE COAL		2,988,213	3,103,559

* Raw coal output by mine is not available for 1979.
** Ceased production in April, 1984 due to fire.

Source: Nova Scotia Department of Mines and Energy

The Lingan mine was opened in the New Waterford area in 1967 to extract coal from the Harbour seam. It is a submarine colliery with three advancing longwall systems serviced by four slopes, or inclined access tunnels (see Box 2-2). With an estimated 78 million tons of in situ coal, and an extraction rate of 60 percent, the potential reserves of Lingan are close to 50 million tons. The coal is processed at the Victoria Junction Coal Preparation Plant. Production is about 1.5 million tons of saleable coal a year, of which 50 to 60 percent is metallurgical grade. The new Lingan-Phalen mine, due to come into production by 1987, will replace the coal from No. 26 mine which was beneficiated to metallurgical grade at the Victoria Junction wash plant (see Box 2-3).

Box 2-2

LONGWALLS

An advancing longwall is a coal face between two passageways, with panels or pillars of coal left between the longwall and the passageways to protect the passageways. Coal is sheared off and deposited on a conveyor as the wall advances. Hydraulically powered, self-advancing face-supports are used immediately behind the cutting face to support the roof. Behind the supports, the roof is permitted to break and collapse on the remaining waste material. The panels protect the passageways.

This method is used on coal deposits not subject to sudden changes in dip, thickness or elevation and overlain by a strata that will completely subside. It is relatively cost-effective, easy to ventilate, and requires less advanced training.

Retreat longwalls are often used where fragile roof or floor conditions exist. This means that two parallel entries are mined along the entire coal panel prior to production commencing. The face then starts at the end of the panel and 'retreats' backward. Because the entries or passageways must be entirely constructed through the length of the mine before mining begins, the lead time is much longer.

The Prince mine, in the Point Aconi area, is a submarine mine extracting coal from the Hub seam by two retreat longwall systems serviced by two slopes. In situ reserves are estimated at 77 million tons which, at the same projected extraction rate as Lingan, suggests recoverable reserves of over 45 million tons. In 1984, the mine produced over one million tons, most of which was sold as thermal coal. However, a wash plant is under consideration which will enable the mine site to deal with increasing stone occurence and higher ash percentage. The quality of Prince mine coal in the meantime will be upgraded at the Victoria Junction wash plant by blending with cleaner fractions of washed coal.

Prior to the fire in 1984, No. 26 Colliery produced approximately 900,000 tons of saleable coal annually from two advancing longwalls. The mine, which had been in operation since 1944, will not reopen.

Novaco Limited, a wholly owned subsidiary of Nova Scotia Resources Limited, has engaged in surface mining from the Sydney Main (or Harbour) seam in the Point Aconi area since 1979. Operations were completed in 1985, and Novaco has no present plans to commence production elsewhere.

The Brogan mine is operated by T. Brogan and Sons Limited in the Point Aconi area. Coal is extracted from the Upper and Lower Bonar seams by a conventional small scale dragline ("cable and bucket") operation. Reserves appear to be limited.

In 1984, Pioneer Coal Company, a subsidiary of Nova Construction Company Limited of Antigonish, took charge of the Drummond mine which has mined Pictou County coal since 1868. Although an exploratory program is still in progress, present projections suggest that the recoverable reserves may consist of approximately 500,000 tons of surface coal, 300,000 tons of underground coal, and 500,000 tons from dumps.

The Evans Coal Company operates the Evans Coal mine in the St. Rose area of western Cape Breton. The mine is a conventional room-and-pillar operation serviced by two slopes, and most of its production goes to thermal and domestic markets within the province.

Selminco Incorporated operates two coal dump reclamation projects: the Princess dump in Sydney Mines and the Summit dump in New Waterford. The Princess dump reclamation project started in 1979-80 and has approximately two years left at 50,000 tons per year of recoverable coal. The Summit dump project started in 1982 and has approximately three years of life left at 60,000 tons per year. Both projects produce about 10 to 20 percent recovery of good grade thermal coal. Negotiations are underway with CBDC regarding the processing of new waste dumps.

The largest part of all coal produced in the province is used by the Nova Scotia Power Corporation to generate electricity. Nonetheless, coal exports were over one million tons in 1983 and almost one-half million tons in 1984. Exports are expected to grow again as Lingan-Phelan comes into production.

Most of Nova Scotia's metallurgical grade coal reserves are found in the Sydney Coalfield, although there is also a small reserve in Pictou County. One of the factors in assessing the quality of metallurgical coal is the degree to which the sulphur content can be reduced using various beneficiation techniques. The optimum techniques have not been identified for substantial quantities of Nova Scotia's reserves. The current projection of 200-250 million tons of metallurgical coal reserves is therefore not absolute.

The only existing user of metallurgical coal in Atlantic Canada is the Sydney Steel Corporation (SYSCO), whose demand can fluctuate substantially from year to year. The remaining metallurgical coal is exported, sometimes for thermal uses. Coal exports are feasible because the major mines in Nova Scotia are close to ocean ports.

The export of metallurgical grade coal fell off in 1984 as the No. 26 mine stockpiles were depleted, and will not pick up again until the new Lingan-Phelan mine comes into production. Coal from Lingan and Lingan-Phelan will go to the Victoria Junction wash plant and a percentage will be recovered as metallurgical grade. The metallurgical content of the Lingan coal, for example, varies from 40 to 75 percent of the raw coal production.

Table 2-2

PRESENT DISPOSITION OF NOVA SCOTIAN COAL (SALEABLE)
(Tons)

	1979	1984
Nova Scotia Power Corp.	979,805	2,420,936
Domestic	45,857	54,307
Industrial	515,031	48,713
NOVA SCOTIA SUB-TOTAL	1,540,693	2,523,956
EXPORTS TO OTHER PROVINCES	636,794	29,363
Brazil	157,334	178,806
France	24,431	28,037
Italy	18,719	29,005
Japan		83,889
Netherlands		66,525
South Korea		84,288
Sweden	125,984	31,826
West Germany	224,000	47,864
INTERNATIONAL EXPORTS SUB-TOTAL	550,468	550,240
TOTAL DELIVERIES	2,727,955	3,103,559

Source: Nova Scotia Department of Mines and Energy

The future market for Nova Scotian coal outside of the province is influenced by three factors: (1) the high ash content of some Nova Scotian coal which restricts its potential applications; (2) the difficulties of expanding markets because of handling costs and fierce competition among producing nations; and (3) the need to meet increasingly stringent emission regulations governing coal use.

Direct use of coal as an end-use energy source within the province is similarly circumscribed by transportation and storage difficulties, as well as environmental concerns. The major domestic end-use of coal is for residential and industrial heating. To expand this market, Nova Scotia must minimize these factors through the use of new technologies such as coal beneficiation and carbogel (see Box 2-3).

Offshore Gas and Oil

When the 1979 Energy Plan was written, the results of the first Venture discovery well (D-23) had only just been announced and its implications were barely appreciated. Since then, more than three dozen offshore exploration wells have been drilled, including four delineation wells at Venture, and plans are proceeding for the development phase of the first offshore natural gas project, the Venture Gas Project (VGP).

Box 2-3

NEW COAL TECHNOLOGIES

Carbogel

Carbogel is the trade name of one process which converts solid coal into a coal-water mixture (CWM) for easier transportation and storage.

The carbogel process was developed by AB Carbogel of Sweden. The procedure begins by grinding the coal to obtain a defined particle size distribution. This is followed by a two-stage flotation system which removes high ash and pyrite. The resulting concentrate is then dried by filtering, and the filter cake is finally mixed with other chemicals.

In April of 1982, EMR Canada, the New Brunswick Electric Power Commission (NBEPC) and the Cape Breton Development Corporation (CBDC) agreed to demonstrate the preparation of carbogel (CWM) at Sydney, Nova Scotia.

Coal Beneficiation

Ash and sulphur content can be reduced in some coals by washing or 'beneficiating'. The coal is cleaned with water containing additives, and those impurities which are heavier than coal sink to the bottom.

The amount of sulphur removed varies, depending in large part upon the end-use of the coal and cost considerations. A deep clean, for example, could lower the sulphur content of a thermal coal from 4 percent to 1.5 percent in addition to lowering the ash content. However, if the cleaning is excessive the recovery rate is low, the amount of coal in the rejects is unreasonably high, and the end-product becomes uncompetitive in price.

Exploration activity accelerated after the signing of the Canada-Nova Scotia Agreement on Offshore Resource Management and Revenue Sharing on March 2, 1982. The Agreement, formally implemented by a series of acts passed by both governments in 1984, assured that resource development offshore would be jointly administered by both Nova Scotia and Canada through the Canada-Nova Scotia Offshore Oil and Gas Board. It also emphasized close cooperation between government and industry to ensure active offshore development.

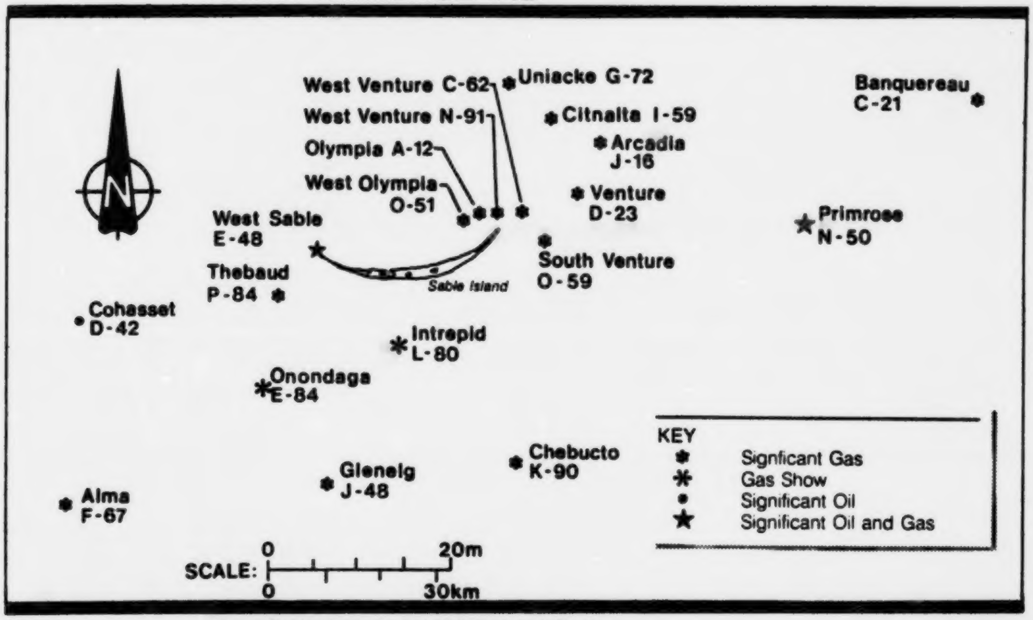
The Agreement required all companies holding lands offshore to renegotiate exploration agreements with the Board. As a consequence, 35 exploration agreements were signed, calling for 46 wells to be drilled by 1988 at an estimated cost of over two billion dollars. In April, 1985, two more "second-round" exploration agreements were negotiated with the Board involving the first new lands awarded since the Agreement was signed. New exploration acreage is expected to be offered on a regular basis.

Exploration activity accelerated during 1982, and continued at a high level throughout 1983 and 1984. Between 1982 and 1985, Mobil, Shell, Petro-Canada, Husky/Bow Valley and Home Oil drilled 31 exploratory and 6 delineation wells, most of them in the Sable Island area. Their efforts have resulted in a number of significant gas discoveries, including West Olympia, West Venture, Chebucto, Alma, Uniacke, Glenelg, Arcadia, Banquereau, South Venture and Olympia.

More recently, a number of exploration wells have been drilled to delineate the extent of the original discoveries in order to firm up reserve estimates and determine the commercial potential of the fields. During 1984-1985, Shell proceeded with delineation drilling on their Glenelg and Alma discoveries. Mobil recently completed a delineation program on their Thebaud discovery, and exploration and delineation drilling is expected to continue in the vicinity of Sable Island to identify additional gas reserves for the Venture Gas Project.

When assessing reserves, drilling results can be described in a variety of ways. A discovery is termed "significant" if the first well on a geological feature shows the existence of hydrocarbons which, when flow-tested, appear to have the potential for production. Sixteen significant gas discoveries and three significant oil discoveries have been made on the Scotian Shelf to date (see Figure 2-2). Of the last 29 wildcat wells drilled, 10 have resulted in significant discoveries for a 34 percent success ratio. This compares favourably with an average success rate of 15 percent in North Sea exploration since 1980. It is now evident that the Scotian Shelf is a "gas prone" rather than an "oil prone" area. However, some small oil fields do exist and may be developed as an indigenous source of oil.

FIGURE 2-2 SIGNIFICANT HYDROCARBON DISCOVERIES NEAR SABLE ISLAND


N
West Venture C-62
Uniacke G-72
West Venture N-91
Citnalta I-59
Olympia A-12
Arcadia J-16
West Olympia O-51
Venture D-23
West Sable E-48
South Venture O-59
Thebaud P-84
Sable Island
Banquereau C-21
Primrose N-50
Cohasset D-42
Intrepid L-80
Onondaga E-84
Glenelg J-48
Chebucto K-90
Alma F-67
KEY
Signficant Gas
Gas Show
Significant Oil
Significant Oil and Gas
SCALE:
0
20m
0
30km

Source: Nova Scotia Department of Mines and Energy

Another measure is "discovered reserves", which measures the volume of gas, oil or condensate which is technically recoverable without consideration of economic constraints. Data from the VGP export application indicate that the discovered reserves for the Venture, Thebaud, and South Venture gas fields are 2.4 trillion cubic feet of gas and 48 million barrels of oil and condensate.

The discovered reserves for the remaining gas finds at Alma, Arcadia, Banquereau, Chebucto, Citnalta, Glenelg, Intrepid, Olympia, Onondaga, Uniacke and West Venture, plus the oil discoveries at Primrose, Cohasset and West Sable are 1.9 trillion cubic feet of gas and 57 million barrels of oil.

Finally, the most recent estimates (1983) by the Geological Survey of Canada assess the ultimate potential for all Scotian Shelf lands as follows:

	GAS (tcf)	OIL (millions of barrels)
High Confidence (95% probability)	7.8 tcf	140.0
Average Expectation (50% probability)	21.8 tcf	540.0
Speculative Estimate (5% probability)	38.9 tcf	965.0

Many of the natural gas fields on the Scotian Shelf also contain a significant volume of valuable natural gas liquids (NGLs). In the liquid values given below, the lower range is typical of normal pressured gas while the higher ranges apply to geopressured gas found in deeper strata. Total amounts available are difficult to estimate because of the wide variation from location to location.

	Liquid Content (Barrels per MMcf of Raw Gas)
Natural Gas	
Ethane	25-45
Propane	16-20
Natural Gas Liquids	
Butane	8-10
Pentanes Plus (Condensate)	17-26

Box 2-4

HYDROCARBON LIQUIDS FRACTIONATION

Gas plants process raw natural gas into 'sales' gas for consumer use by removing liquids and contaminants which are normally present in the raw gas. Initial processing is by gravity separation of the associated condensate and water from the raw gas, and further liquid removal is achieved by one or more liquid condensation processes. The hydrocarbon liquids are recovered as a mixture for further treatment, and may then require separation into individual, saleable products such as propane, butane and pentanes plus. Separation is achieved by fractionation, which involves changing the temperature, pressure and composition of the mixture in stages, utilizing differences in the boiling and condensation points of each product.

Mobil and its partners have been formulating development plans for Venture and more recently for adjacent fields as well. In 1983, Mobil assembled an engineering team in Halifax and appointed a consortium to assist in the management, procurement and construction of the Venture Gas Project. Sable Gas Systems Ltd. was incorporated in 1983 with the objective of constructing and operating a natural gas transmission system to the United States border. That same year, federal and provincial review panels conducted an extensive environmental and socio-economic impact assessment of the project, and recommended approval in their final reports.

In January, 1984, a development plan was submitted by Mobil and its partners to the Canada-Nova Scotia Offshore Oil and Gas Board to fulfill one of the requirements for obtaining a production license. In the spring of 1985, sales agreements were signed with United States transmission companies.

In July, 1985, Mobil and its partners made an export application to the National Energy Board, which indicated that the total cost of the project, including the transmission system to the United States border, would be approximately $2.9 billion. It was projected that initial production would commence in the fall of 1990, assuming that the export and import approval process required in both Canada and the United States proceeded expeditiously.

The main barrier to offshore natural gas as an energy source is the cost of the technology required in the offshore environment. The high cost of bringing gas ashore requires a much larger immediate market than Nova Scotia or the Maritimes can provide and, to overcome this hurdle, more than 90 percent of the VGP's production will be sold in the north-eastern United States.

Given the high costs of offshore natural gas production, transmission, distribution and conversion, it is likely that its use within the province will be limited by economics to the major population concentrations. The province intends to rely on federal assistance in overcoming the high cost of gas distribution infrastructure and tariffs, and their limiting effects on the competitiveness of gas in end-use markets. The required federal assistance should be similar to that provided to Quebec under the National Energy Program. Another barrier that may arise is ordinary consumer resistance to a new product. In addition to competitive prices, information programs are likely to be required to encourage users to switch from more traditional sources.

River and Tidal Hydro

River hydro has played an important part in Nova Scotia's history by providing power for many small communities. Although most of the river hydro generating plants are now operated by the Nova Scotia Power Corporation as part of the province-wide system, many of the older plants were originally installed as local units. Hydro units can be designed for either base load or peaking purposes. The new Wreck

Cove plant, which can generate 200 megawatts or well over half of the province's total hydro capacity, is designed essentially as a peaking plant (see Box 2-7). In 1984, river hydro accounted for 4.6 percent of primary energy demand in Nova Scotia.

As of 1985, the Nova Scotia Power Corporation has over 50 hydro generating plants at 33 locations, two of which (Gisborne and Fourth Lake) have been added since 1979. In addition, there are several small private companies generating electricity from hydro power, with capacities in the 100 to 300 kilowatt range. Total generating capacity is just over 360 megawatts, and the average annual energy output is close to 1000 GWh. Depending upon water level variation, however, energy production can fluctuate by as much as 20 percent annually.

The major constraint to increased hydro generation in Nova Scotia is quite simply the lack of rivers which are suitable for hydroelectric generation. The remaining potential is small and distributed over a number of different sites.

The possibility of tidal hydro, or generating electric energy from the Bay of Fundy tides, was recognized early in this century but the first comprehensive feasibility study was not done until the late 1960s. Subsequent studies in 1977 and 1982 have endorsed the technical and economic feasibility, and a pilot project has been completed at the Annapolis River Basin. The Annapolis Project is now part of the NSPC's generating system, and will produce 0.3 percent of the province's primary energy demand in 1986.

Aside from the difficulties caused by the sheer size and cost of the project, the main barrier to the development of tidal power is that it produces energy in periods of a few hours duration on each tide. These do not necessarily coincide with peak load demand for electrical power. Indeed, because tides do not rise and fall at the same time each day, the two periods when tidal power would be available vary from day to day.

The first tidal power studies paid considerable attention to "retiming", or storing the power produced so that it would be available evenly over the day. Because the retiming options were not economic, however, the 1982 Fundy Tidal Power Update assumed that power would be delivered directly to the utility unretimed. Given the total electrical load in the Maritimes, only a portion of the energy available from tidal power could be absorbed in the region, and 60 percent of proposed site A8 (Cumberland Basin) or 90 percent of proposed site B9 (between Economy Point and Cape Tenny in the Minas Basin) would have to be sold to the New England or New York market.

It is still too early to assess the component life and maintenance requirements of the Annapolis demonstration project which commenced in 1984, but results to date have been very favourable. It consists of a single turbine on the causeway between Granville Ferry and Annapolis Royal with a generating capacity of 20 megawatts. The 130,000 kWh which can be generated per day (or 50,000 MWh per year) would supply a town of 20,000 people with electricity.

Once the Annapolis project has been fully evaluated, and all its data on cost, wear, and maintenance requirements has been incorporated into tidal power projections, the next step will be to look at a full-scale plant at either site A8 or B9. The major difference between the two sites is the potential size of the station. While various options are still open, the 1982 report suggests that A8 would have 37 generators and a capacity of about 1100 megawatts, and B9 would have 128 generators and capacity of about 4600 megawatts. The A8 site is projected to cost (1981)$2,000 million and produce 3200 GWh annually; the B9 site would cost approximately (1981)$7,000 million and produce 14,000 GWh.

Forest Biomass

Forest biomass is generally defined as the total amount of wood fibre available from the forests, including the stump, stem, and branches. It is normally broken into two categories: merchantable wood and forest residue. Forest biomass supplied 4.8 percent of the province's total primary energy demand in 1984. Merchantable wood, which includes only the larger stems of the tree, is used both for commercial purposes (such as saw logs, pulp logs, etc.) and for heating in the form of roundwood or waste products from forest processing.

Forest residue, on the other hand, is forest material which has no value using conventional harvesting practices. It includes:

- Slash, or the tops and branches left over after a harvest of merchantable wood, often representing about 50 percent of the wood fibre in the tree;

- Silviculture thinnings, or material removed to promote the growth of merchantable wood in the stand;

- Uncommercial species, or trees such as grey birch, poplar and aspen, that are difficult to sell in any form;

- Budworm infested or diseased trees, standing dead, which can be harvested for pulp or sawlogs during the first year or so but are of no value after that;

- Poor quality stands, or stands that cannot be economically harvested using existing forest practices because they contain undesirable species, a low quantity of wood fibre per acre, crooked or rotten trees, or small diameter trees. Over 10 percent of woodland in the province falls within this category.

Wood has always played a role as a fuel supply in Nova Scotia, although it has been traditionally more popular in certain parts of the province than in others. Surveys indicate, for example, that wood plays a far more important role in central and south-western Nova

Scotia (where it supplies an estimated 25 percent of primary residential fuel demand) than in the Halifax County or Cape Breton areas (4 to 5 percent). Roundwood fuel (or chunk wood) has, on the whole, been limited to residential or small-scale industrial and commercial space heating.

Traditionally, the major users of wood processing wastes have been the forest industries themselves. All four pulp and paper plants in the province use some of their own wood wastes (called "hogged fuel") in their operations. Pulp operations create a great deal of bark and sawmill operations create slabs, sawdust and planer shavings. The volume of mill waste or bark created varies directly with the levels of sawmill or pulp company production. Some of these plants have recently begun to harvest forest residue such as diseased trees in order to obtain wood chips for fuel.

In the past few years, as energy costs have increased, there has been a significant growth in the use of wood as both a primary and an end-use fuel. Energy generation from wood has more than doubled since 1979. However, the future use of merchantable wood for fuel is severely limited by the fact that the amount of softwood presently harvested already exceeds the Annual Allowable Cut (AAC), and hardwood production is rapidly approaching the AAC.

Since the AAC limits the increase in harvesting of both softwood and hardwood, forest residue will have to play an increasing role if wood is to maintain its role as an energy resource. However, the forest residue available for energy purposes is extremely difficult to assess for a number of reasons. The amount of residue available from slash depends to a large degree upon the amount of wood harvested, which in turn depends upon economic and market conditions throughout the forestry sector. The question of defining "unused commercial species" likewise depends upon market and pricing projections in the logging industry rather than the energy sector.

Table 2-3 suggests that over one million bone dry tons of unused forest residue is potentially available on an annual basis from existing forest harvesting or wood product manufacturing operations.

Table 2-3

CURRENT ANNUAL SURPLUS OF FOREST BIOMASS AVAILABLE FOR ENERGY PURPOSES

(in '000s bone dry tons)

	Supply	Demand	Surplus
Logging and Silviculture Residues	1020.6		1020.6
Roundwood For Fuel	271.3	271.3	
Hogged Waste From Manufacturing Wood Products	183.4	143.8	39.6
TOTAL	1475.3	415.1	1060.2
BTU EQUIVALENCY (trillion)	25.5	7.2	18.3

In addition to the logging residue available from the harvesting of merchantable wood, substantial biomass resources are available which are not considered as part of the AAC calculation. These include areas of budworm diseased softwoods. unmerchantable species such as alder, and other poor quality stands. Such stands are "one-shot" energy resources in most cases. Once harvested for energy, the land would be reforested with commercial species. Current estimates of forest biomass available from these sources is 18.7 million bone dry tons or 322 trillion Btu. Many of these stands, however, are in remote locations and are, therefore, uneconomical as a fuel source.

Wood chips, which can be produced from any form of forest residue and do not create competition for merchantable wood supplies, seem to be the most feasible fuel from forest residue. Recent studies indicate that wood chips can be produced economically, and that because of the relatively low operating costs there is a market among rural industry and institutions for use in hot water or high-pressure boilers.

The major barriers to the increased use of wood chips are the absence of a fuel supply infrastructure and the relatively high capital costs involved in installing appropriate fuel handling and combustion systems. Transportation and marketing require a coordinated approach, and this may create administrative difficulties because of the large number of small, privately-owned woodlots involved. Finally, the environmental effects of removing forest residue must be given consideration, although recent studies suggest that problems in this area arise from the methods used and not from the amount harvested.

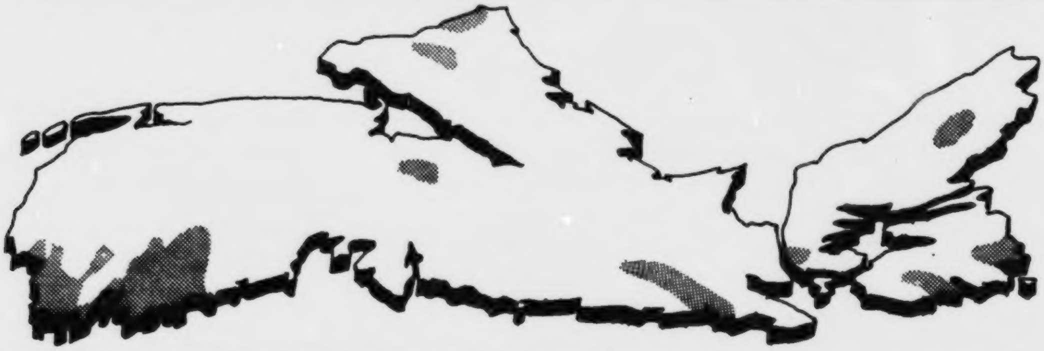
The potential benefits to the province of increased use of wood chips and other forms of forest residue, both in reduced operating costs and in employment, are sufficiently high that the issue deserves, and is receiving, further attention.

Peat

There are two types of peat found in the province: horticultural peat and fuel peat. Fuel peat is classified as a fossil fuel, and therefore is of the same general family as coal, oil and natural gas. Essentially, it is a coal deposit in the making. Normally found in boggy areas, it is harvested by cutting strips in surface deposits which are then rolled to dry somewhat like grass sods. The use of peat as a fuel is not well known in North America but it is a significant source of thermal heat in Ireland, Finland and the U.S.S.R. which have commercial-sized thermal generating plants fuelled entirely by peat.

Nova Scotia has an estimated 400,000 acres of peatlands, of which 81,800 were investigated during the Peatland Inventory Program. Most of the fuel peat identified to date is in southwestern Nova Scotia in Queens, Shelburne and Yarmouth counties as shown in Figure 2-3. Approximately 40 percent of the 95,000 acres of peat found here is classed as fuel peat, and exploitable reserves are estimated at 14 million tons (or the equivalent of over 2 million barrels of oil). The peat resources in the rest of the province are on the whole best suited for horticultural uses.

FIGURE 2-3 PEATLAND CONCENTRATION REGIONS IN NOVA SCOTIA



Source: Nova Scotia Department of Mines and Energy

Although the potential of peat is limited by storage, handling and transportation difficulties, it has considerable potential for some areas of the province. Peat production is relatively labour-intensive, and this can make it an attractive fuel source in high unemployment areas that do not have easy access to other energy resources. Moreover, harvesting peat for thermal energy can facilitate the development of other peat-based industries such as peat moss sales and carbon filter production. An additional advantage of peat as a fuel is that it can be harvested and burned in an environmentally sound manner.

Using peat as a fuel would require the installation of solid fuel handling systems and solid fuel boilers or furnaces, making it most suitable for small industrial or commercial operations. In addition, there are major concentrations of exploitable fuel peat in the Barrington area and at Lake Rossignol which total approximately 7 million tons.

Municipal Solid Waste (MSW)

As the cost of developing new landfill sites continues to rise and environmental concerns grow, refuse fired energy plants (RFEPs) are becoming an increasingly common and economical solution to public waste disposal in large urban areas in the United States and Canada. As existing landfill sites in Nova Scotia near the end of their useful lives, municipal governments should seriously consider RFEPs. Even though traditional landfill sites will continue to be necessary for construction wastes, non-combustibles and certain other types of refuse, site-specific feasibility studies for municipal RFEPs are expected to occur before the end of the decade.

The best market for a municipal RFEP is a large steam consumer with a relatively stable demand who can use the plant's output on a supplemental basis. The major barriers are usually the absence of a large-scale steam consumer near the RFEP site and the potentially complicated administration required to coordinate the municipalities and customers involved. The fact that RFEP costs per ton of capacity tend to increase as the size of the installation decreases limits the number of Nova Scotian municipalities which can cost-effectively consider this option, although this problem can also be addressed by using other refuse (such as wood wastes or industrial waste) in combination with municipal waste.

Because the viability of municipal RFEPs is largely decided by the cost of more traditional refuse disposal methods rather than by energy production costs, it is very difficult to assess the potential for the purposes of an energy plan. Theoretically, given a sufficient number of appropriate steam consumers located close to feasible RFEP sites, 2.6 billion pounds of steam (or 3.6 trillion Btu of energy) could be generated annually from municipal solid wastes within the province.

Onshore Petroleum and Oil Shales

Oil exploration in Nova Scotia originally began in the mid-1800s when surface oil seeps, oil-filled cavities in gypsum, and oily sandstones were discovered in several areas. Oil seeps near Lake Ainslie attracted particular attention, although drilling also took place in the Cumberland and Stellarton Gap sub-basins and around the Bras D'Or Lakes.

Since 1981, two private sector exploration programs have been conducted, including wells at Bras D'Or, Malagawatch, McIvor Point, Scotsburn, and the Strait of Canso area.

In July 1984, the Petroleum Resources Act was proclaimed which, together with the regulations proclaimed in 1985, established a very favourable fiscal regime for onshore exploration programs. Negotiations are in progress on the issuance of licenses under the new Act, and several exploration programs should be initiated in the next few years.

As a result of the 1979 Energy Plan recommendations, the Nova Scotia Oil Shale project was undertaken. Although there is no expectation of immenent commercial exploitation, the study of the Stellarton basin will result in valuable information on the relationship between oil shale deposits and coal or petroleum deposits. This will assist in coal and petroleum exploration programs, as well as in assessing the economic viability of exploiting oil shales through simultaneous mining of both coal and shales.

Although previous examinations of the Big Marsh area proved discouraging, geological similarities with a potentially productive area in New Brunswick (the Albert formation) warrants further examination. Oil shale is not, however, considered a significant energy resource within the time-frame envisioned by **Energy Plan, 1985**.

Uranium

Because of the recommendations of the McCleave Commission, which have been accepted by the Nova Scotia government, uranium has not been taken into consideration as an energy resource.

Renewable Energy Sources

The remaining energy sources available to Nova Scotians are solar, wind and agricultural wastes. Based upon the demonstration projects which have taken place over the last five years, it appears that for the foreseeable future, these energy sources can best be utilized for small-scale projects in appropriate situations. They are not likely to have a measurable impact on overall provincial energy supply in the immediate future.

Solar energy has been the most successful of these alternatives, usually as a supplementary energy source for homes and certain small businesses. Even the simplest solar system, a south-facing double window, yields a net heat gain throughout the year.

Solar energy can be divided into three categories: passive solar systems, active solar systems and photovoltaic systems (see Box 2-5). Passive solar systems use building design features to capture and store solar energy. Active solar systems take more specific measures to capture and store solar energy, and then use mechanical equipment to distribute the heat energy. Photovoltaic systems convert sunlight directly into electricity.

There are at least 350 homes in the province known to have been specifically designed to take advantage of passive solar heating, but countless more homes do so to a limited degree. There are also about 500 residential solar hot water systems within the province, and one residential photovoltaic system.

Box 2-6

SOLAR HEATING

Passive solar systems use light from the sun to heat an enclosed area directly with a minimum of mechanical equipment. As solar radiation passes through window glass and strikes surfaces within the building, it changes from short wavelength, radient energy to longer wavelength, infra-red energy. Since glass is almost opaque to infra-red radiation, the sun's energy becomes trapped in the building, causing it to warm the interior.

Active solar systems use mechanical equipment to capture and transfer solar energy. The most common and cost effective active solar systems are used for heating (or preheating) domestic hot water. On a residential scale, these systems typically consist of several south facing solar collectors or panels mounted on a roof. Water or antifreeze is circulated through the panels to a heat exchanger in the basement. The preheated water then normally passes through a conventional hot water heater.

Photovoltaic systems directly convert solar energy to electricity. Photovoltaic panels are made from thin layers of silicon which are placed on a stiff backing material and then covered with a metallic grid and protective glazing. Photons of light are absorbed into the silicon, and cause the silicon atoms to become ionized thus creating a voltage potential and an electric current.

Many of these small-scale systems were designed or installed since 1979 with the assistance of demonstration project grants in order to determine the most appropriate approaches for Nova Scotia conditions. The large majority of these involved domestic water heating or passive solar additions (greenhouses). At this time, solar energy is still at the developmental stage in climates such as ours. In the immediate future, solar energy in Nova Scotia is likely to be utilized primarily by individual homeowners or small businesses.

The barriers to solar heating vary. Passive solar heating requires a south-facing exposure, as well as an open interior design or a system that facilitates the flow of air. About 30 percent of the existing housing stock could take advantage of passive solar heating, although the cost-benefit ratio would vary from situation to situation.

At the moment, the main barrier to increased use of active or photovoltaic solar energy is simply price. Most systems are not yet cost-effective in Nova Scotia unless other energy sources are unavailable, although prices are expected to continue to decline in the future.

Wind energy is really another form of solar energy. Air which is warmed by the sun tends to rise causing cooler air to move laterally to replace the rising warm air. About 2 percent of the radiant energy reaching the earth is converted by this process into wind energy.

The amount of energy potential in wind is proportional to the cube of the wind speed. When the windspeed doubles, the energy potential increases by a factor of eight. Site location is therefore critical, since a wind turbine at a site with an average wind speed of 12 mph would produce almost twice as much energy as a turbine at a site with an average wind speed of 10 mph. On the negative side, however, a turbine designed to use an average wind speed of 10 mph must also be able to withstand gusts of 80 to 100 mph which produces 1,000 times the energy. This creates considerable technological and cost difficulties.

Nova Scotia's wind conditions are among the most favourable in Canada for electrical generation, since average annual wind speeds are 10 to 12 mph. There are, at present, approximately fifty privately owned wind turbines in the province, with a total capacity of about 75 kilowatts. In addition, the Nova Scotia Power Corporation owns a 250 kilowatt unit at Wreck Cove.

Wind energy technology is still very much at the pilot project stage and, aside from Wreck Cove, it has been used primarily for domestic energy generation in Nova Scotia. Wind generators have had some success in isolated locations which would otherwise have high initial utility connection charges, but careful design, construction and installation is essential for such applications to be effective.

With respect to energy from **agricultural residue**, three possible sources have been studied: crop residues, manure from livestock or poultry operations, and cull fruit and vegetables. There are difficulties in the collection and transportation of all three sources, as well as technical barriers to their use.

The use of crop residues is most promising, although even here the main potential in the short term appears to lie in individual projects whereby farm waste is used to reduce the farm operator's own internal energy costs.

Imported Oil

Nova Scotia's oil imports have decreased dramatically since 1979, but the province's proportional dependence on oil still remains higher than the Canadian average (see Figure 1-18). Although major gains have been made in substituting coal for oil in electrical production, oil continues to be a necessary import in sectors, such as transportation, where substitution potential is limited. Crude oil accounted for 63.9 percent of primary energy demand in Nova Scotia in 1984.

Nova Scotia currently produces no oil. We import both crude oil for refining in the province and refined petroleum products (RPPs). Nova Scotia ships some refined petroleum products for sale in other provinces. The sources of the province's crude oil receipts have undergone considerable change since 1979 as Mexican and Venezuelan sources replaced Middle Eastern producers (see Table 2-4). The countries from which the province imports oil are likely to continue to alter from year to year as price, availability and transportation costs fluctuate.

Table 2-4

TOTAL RECEIPTS OF CRUDE OIL BY ATLANTIC CANADA REFINERS
(million barrels)

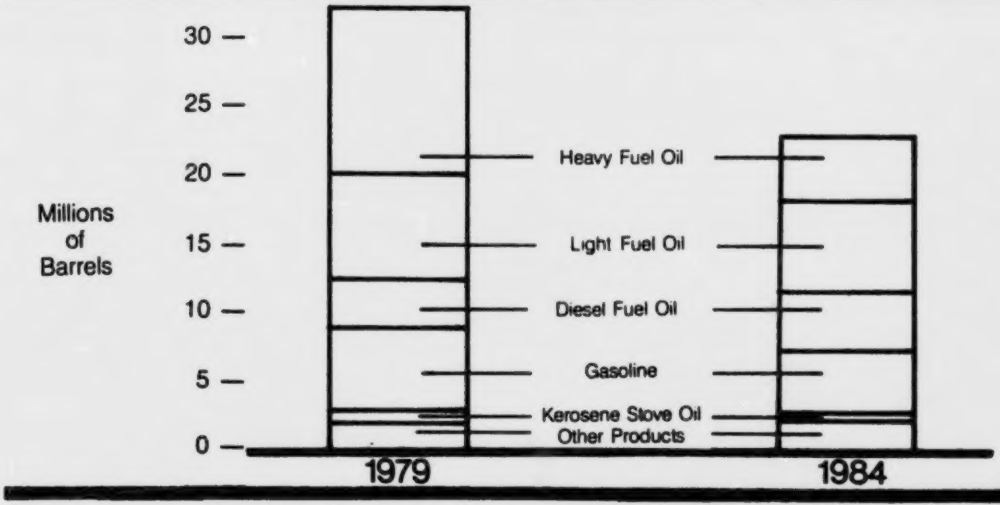
	1979	%	1984	%
DOMESTIC	0.0	0.0	16.0	31.1
IMPORTS				
Mexico			8.4	16.3
Venezuela	37.2	31.7	8.4	16.3
Nigeria			5.1	9.9
Other	80.2	68.3	13.6	26.4
TOTAL RECEIPTS	117.4	100.0	51.5	100.0

Source: Nova Scotia Department of Mines and Energy

Domestic crude from western Canada accounted for a significant share of Nova Scotia's crude oil receipts in 1983 and 1984, largely because of the federal government transportation subsidy. However, the proportion of imports is likely to rise again in the immediate future as a result of deregulation. By the 1990s, however, imports are likely to drop as oil and gas development continues in offshore Atlantic Canada. Natural gas liquids associated with Nova Scotia's offshore gas production, such as pentanes plus, could be used by local refiners with some upgrading, and Hibernia oil appears to be of the type amenable to processing in the Maritimes.

As Figure 2-4 indicates, Nova Scotia's consumption of refined petroleum products has decreased dramatically since 1979 in every significant product sector except diesel fuel.

FIGURE 2-4 NOVA SCOTIA REFINED PETROLEUM PRODUCT SALES, 1979 and 1984

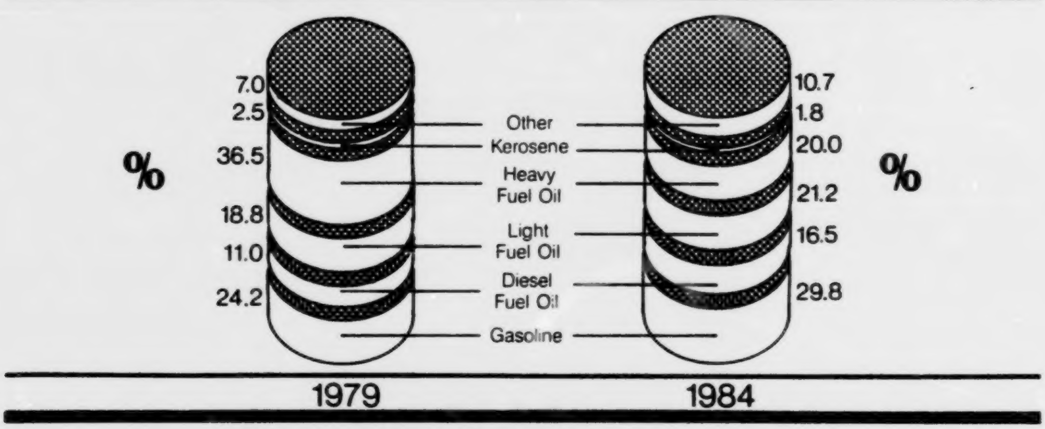


Source: Nova Scotia Department of Mines and Energy

Because of the drop in demand both in the region and in export markets, Atlantic Canadian refineries have an overcapacity at the moment. Nova Scotia refineries have a capacity of 100,500 barrels per day. Eighty percent of this capacity was utilized in 1984.

As total demand dropped, the composition of the market for refined petroleum products also altered significantly. Figure 2-5 shows the percentage change in market share for each of the major refined petroleum products.

FIGURE 2-5 MARKET SHARES OF REFINED PETROLEUM PRODUCTS, NOVA SCOTIA, 1979 and 1984



Source: Nova Scotia Department of Mines and Energy

Because the proportionate demand for gasoline and diesel fuel has increased and demand for heavy fuel oil has decreased, the refineries have altered their product mix accordingly. This is one reason why Point Tupper, which produced predominantly heavy fuel oil, closed while the Imperial Oil facility in Dartmouth, which produces a lighter product, was upgraded.

The rationalization and upgrading that has taken place to meet market demand gives the refineries more flexibility with respect to the varieties of crude oil that can be used, and more sophistication in blending to the desired mix. Decontrol should allow the refineries considerably more choice in the mix of crudes obtainable, allowing them to better respond to the market. On the other hand, it could negatively affect the overcapacity already existing by making imported refined petroleum products less expensive, cutting into the sales of the local refineries. Most oil companies do not have their own refineries in Atlantic Canada because that would create a series of small, uneconomic operations. Instead, they buy products made to their specifications from existing refineries and sell them under their respective brand names.

The move by Atlantic refineries to produce light and middle distillates, although dictated by the market, has other implications. Canada's oil reserves are weakest with respect to light crudes, and strongest with regard to heavy crudes. It is costly to upgrade heavy crude to synthetic light crude, which can in turn be converted to the lighter refined products (see Box 2-6). There could be a concern, therefore, that Atlantic refineries are temporarily "locked into" light crude, which might be difficult to obtain domestically in the event of an international crisis. This situation could be eased once offshore Atlantic oil and gas production comes on stream, but it remains a concern in the next five or more years.

Box 2-6

FRACTIONAL DISTILLATION

A petroleum refinery derives petroleum products from crude oil by subjecting it to a number of physical and chemical processes. One of the most common is fractional distillation, in which crude oil is heated to a temperature that vaporizes all of the components except heavy oil for individual retrieval in a fractionating tower.

The fractions are broadly classified into four groups: gases (methane, ethane, propane and butane); light distillates (automotive and aviation gasoline and naptha); middle distillates (kerosene, diesel fuel, jet fuel and furnace oil); and residual products, including heavy fuel oil and asphalt.

Crude oil is normally divided into two categories, light and heavy. Whereas light crude is characteristically light-coloured, easy-flowing, low in sulphur content and high in hydrogen, heavy crude is dark, thick, sticky and viscous with a high asphalt, sulphur and carbon content. Heavy crudes have some similarities to the 'residual product' of fractional distillation.

A light crude, for example, might provide 85 percent usable light oils while a heavy crude may only provide 55 percent light oil. Rather than refine more crude to produce the desired level of light oil and therefore build up surplus stocks of heavy oil, a refinery may install additional processing equipment to increase the proportion of light products.

This process, in which the molecules contained in the heavier, larger and more complex hydrocarbon molecules are broken down into lighter and simpler ones to make more light and middle distillates, is known as 'cracking'. An even more sophisticated technique has also been developed, called 'hydrocracking' whereby a catalyst is used together with hydrogens under high pressure.

Although oil prices have stabilized recently and a supply surplus exists, the danger always remains that international events or the re-emergence of OPEC as a viable cartel could cause a sudden supply crisis. In that case, domestic supply could be severely limited because of transportation constraints and prior market commitments.

Electricity

Because of its versatility and convenience, electricity is the most popular end-use energy source other than refined petroleum products. During the late 1960s and early 1970s, electrical consumption increased at a greater rate than overall energy use. Since electrical generation is under provincial jurisdiction and can involve a variety of primary fuels, including indigenous coal, it becomes a critical component of provincial energy planning. The Nova Scotia Power Corporation (NSPC) provides almost 95 percent of the generation and 99 percent of the transmission of electric power in the province.

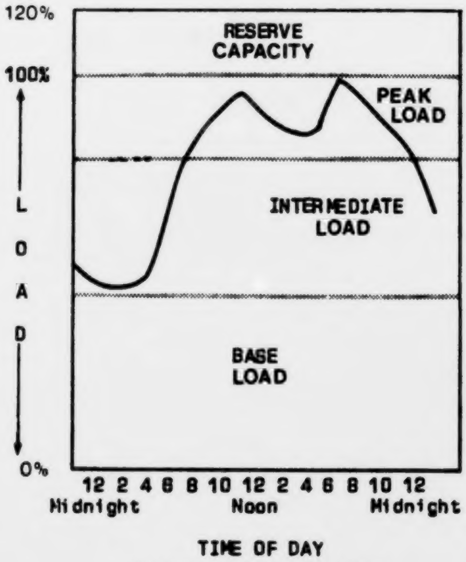
Electrical energy cannot be stored economically in large amounts, so the installed capacity of an electrical utility must be sufficient to meet peak demand and still have reserve capacity available to handle unexpected events such as power outages (see Box 2-7). Immediate and long term energy needs and priorities must be carefully balanced. The long range plan must of necessity be flexible, since circumstances can easily change, but its purpose is to provide the context within which short range plans may be developed. The planning horizon for electrical utilities varies from 10 to 30 years because of the length of time required to construct and amortize new facilities.

Box 2-7

ELECTRICAL GENERATING CAPACITY

Base load generating plants are generally high capital cost, high efficiency units specifically designed to operate continuously at or near their maximum capacities. Intermediate load units are lower efficiency units, often older units installed as base load units and now operating variably at between 20 percent and maximum capacity. Peaking units are low capital cost, less efficient units, which are intended to operate only for short periods daily during the peak system load.

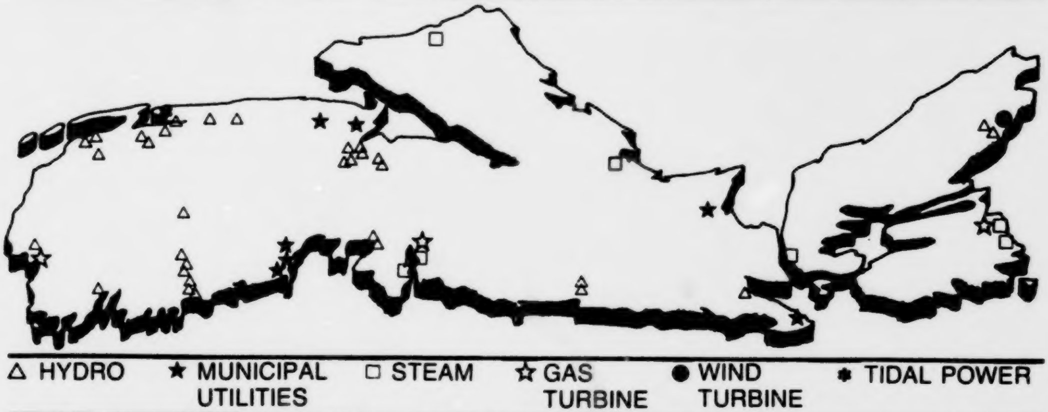
Since reliability is a critical component of an electrical system, it is necessary to also install a reserve capacity. This is normally about 20 percent of total load capacity to ensure that any individual generating unit breakdown or outage will not disrupt the system.



WINTER PEAK DAY LOAD

Figure 2-6 shows the location of NSPC generating stations, together with the number of units at each location, the year of installation, fuel source and generating capacity. In addition, there are a number of private generation systems using a variety of energy sources (steam, hydro, diesel, wind). The size of the private generation systems ranges from 29.5 megawatts (Nova Scotia Forest Industries) down to 0.5 kilowatts for rural wind generating systems.

FIGURE 2-6 NOVA SCOTIA POWER CORPORATION GENERATING STATIONS



Nova Scotia Power Corporation Generation Stations with a capacity of over 200 Megawatts (MW)

LOCATION	NO. OF UNITS	YEAR INSTALLED	ENERGY SOURCE	GENERATING CAPACITY
Lingan	4	1978,80,83,84	Coal	601.5 MW
Point Tupper	2	1969,1973	Bunker C	230.5 MW
Trenton	5	1951-1969	Coal	210.0 MW
Tufts Cove	3	1965,72,76	Bunker C	350.0 MW
Wreck Cove	2	1978	Hydro	200.0 MW

Source: Nova Scotia Power Corporation

Until the late 1960s, coal was a major source of thermally generated electrical energy in Nova Scotia. In 1956, coal supplied over 45 percent of the primary energy input to the utility sector (with hydro providing most of the rest), and by 1966 it claimed almost 68 percent of the rapidly expanding market. At that point, however, the availability of heavy fuel oil at an extremely low price caused oil to displace coal as the main energy source for electrical generation. By 1979, only 19.8 percent of Nova Scotia's electrical energy production was generated by coal.

Given rising oil prices and concerns about security of supply, the 1979 Energy Plan strongly recommended that the electrical system continue to revert to coal for its primary energy input as rapidly as possible. The economics of international oil pricing and, more particularly, the problems of supply security were such that it appeared worthwhile to bring new coal-fired units into production somewhat before they were required to meet load requirements. There was, as well, the added benefit of using an indigenous fuel to retain the economic benefits of energy production within the province.

As a result, by 1984, coal accounted for over 70 percent of the electricity generated in the province, with oil and hydro accounting for approximately 15 percent each.

Table 2-5

NSPC INSTALLED CAPACITY* AND PRODUCTION

	1979		1984**	
	Installed Capacity (MW)	Net Production (GWh)	Installed Capacity (MW)	Net Production (GWh)
Coal Fired	331.3	1199	922.8	4879
Oil Fired	745.5	3363	745.8	995
Gas Turbine (peaking)	205.0	7	168.6	0
Hydro (primarily peaking)	354.9	1136	361.4	993
Wind	0.0	0	0.3	0
Purchases (Net)	0.0	349	0.0	-6
Tidal Purchases	0.0	0	0.0	8
TOTAL	1636.7	6054	2198.9	6869
		BY PERCENTAGES		
Coal Fired	20.2	19.8	42.0	71.0
Oil Fired	45.6	55.5	33.9	14.5
Gas Turbine (peaking)	12.5	0.1	7.7	--
Hydro (primarily peaking)	21.7	18.8	16.4	14.5
Wind	0.0	0.0	0.0	0.0
Purchases (Net)	0.0	5.8	0.0	0.0
TOTAL	100.0	100.0	100.0	100.0

* As of March 31
** Includes Lingan IV

Source: Nova Scotia Power Corporation Annual Reports
Unpublished Nova Scotia Power Corporation data

2.2 ENERGY EFFICIENCY

Overview

Increased energy efficiency provides an alternative to increased energy production in achieving the optimum relationship between supply and demand, or energy stability. Improved energy efficiency not only reduces ongoing energy supply costs, but also prolongs the availability of indigenous energy reserves.

Energy consumers, regardless of sector, can normally be categorized as belonging to one of five groups:

1. Those who do not recognize the potential of improved energy management;

2. Those who recognize the potential, but are insufficiently motivated to take any action;

3. Those who recognize the potential and are motivated to take action, but are adverse to risking the necessary investment of time or money;

4. Those who recognize the potential, are motivated and would be prepared to take action but are stopped by technical or financial barriers; and

5. Those who recognize the potential and have the ability to research, evaluate and afford appropriate solutions.

There is some evidence that, after the conservation programs of the past decade, the fifth type of consumer has already adjusted to more efficient consumption patterns. New conservation savings can still be generated by consumers in the first four categories, but this will require more imaginative approaches by government.

Lack of awareness of the potential of improved energy management can be best addressed by information programs. Lack of concern can be addressed by both information and regulatory initiatives. A reluctance to make the necessary investment of time or money can be alleviated by risk reduction measures such as demonstration programs.

Fiscal or technical limitations can be addressed by incentives of various types. An effective mix of programs is required to address the full range of problems simultaneously. It is of little benefit to inform energy consumers of the benefits of improved energy management unless they are also motivated to take action, or to motivate energy consumers to take action if they are not prepared to invest the time or money required.

Information programs can address the full range of barriers, and are critical to improving energy management. At the most basic level, information programs can address the initial barrier of unawareness or the problem that many consumers still do not know the benefits of energy conservation. Information programs can also play a role in motivating as well as informing the consumer by publicizing clear, persuasive arguments concerning, for example, the effects of turning down thermostats or hot water temperatures. Sophisticated information programs can also assist in risk reduction, and even in overcoming what may be unnecessarily perceived as financial or technical barriers. Post-program audits can also play a valuable role in this regard since factors such as the effects of inflation or annual variations in temperature can make it difficult for the individual consumer to assess the full impact of conservation measures.

Regulatory measures are most effective in dealing with lack of motivation. These can range from legislating speed or weight limits to encouraging better and more energy efficient traffic management systems within urban areas.

Risk reduction programs are those which reduce the real or perceived risk to the individual consumer wishing to implement energy management improvements. They can range from simple information, to demonstration projects to establish the viability of new technologies, to the encouragement of innovative private sector financing for energy management improvements.

Incentive programs are those which directly assist the consumer in overcoming financial or technical barriers. Government initiatives in the past half-dozen years have placed considerable emphasis on assisting consumers to overcome these types of barriers by grants or other financial assistance. While the results of this approach have been significant, the ongoing cost is high and grant programs are less likely to play a significant role in the coming decade.

Residential Sector

The residential sector in Nova Scotia has exhibited some of the strongest improvements both in energy efficiency and switching from refined petroleum products. There is considerably more potential, however, which can be found in an analysis of the nature of the housing stock and patterns of tenure. Table 2-6 and Figure 2-7 present historical energy use in this sector between 1979 and 1984.

Housing stock in Nova Scotia not only varies from the rest of the country, but also within the regions of the province itself, and this has considerable implications for energy management potential. Older housing offers greater potential for residential conservation measures and Nova Scotia's housing stock is relatively old. Approximately 36 percent were built prior to 1946 compared to 23 percent in the rest of Canada.

Table 2-6

RESIDENTIAL ENERGY USE
1979 and 1984
(trillion Btu)

	1979	1984
BY FUEL		
Coal	1.1	1.4
Electricity	7.2	8.4
Wood	2.7	5.8
Light Fuel Oil	26.5	18.2
Kerosene	4.1	2.1
Heavy Fuel Oil	0.5	1.1
LPG (Propane)	0.7	0.8
TOTAL USE	42.8	37.8
Refined Petroleum Products Percentage	74.0%	60.0%
DEGREE DAYS(DD)	4,057	4,031
NO. OF UNITS	260,000	280,000
THOUSANDS OF BTU/DD/UNIT (Btu per degree day per unit)	40.6	33.5
Percentage of Total Provincial Use	22.0%	23.0%

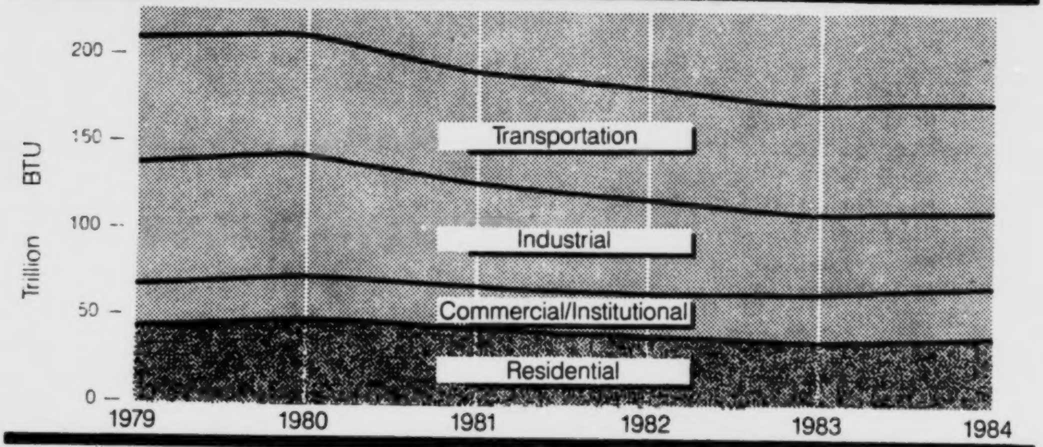
Source: Nova Scotia Department of Mines and Energy

Homeowners are more likely than renters or landlords to participate in general conservation measures, and Nova Scotia has a higher percentage of owner-occupied homes than the Canadian average. Because heat and hot water are included in the rental charges for almost three-quarters of the province's rental units, the incentive to conserve is correspondingly reduced, and specialized conservation initiatives are required if rental units are to be significantly affected.

Only in three counties do rental units account for more than 25 percent of housing units: Halifax (43 percent), Kings (30 percent) and Colchester (26 percent). Programs aimed at rental properties can therefore be geographically targeted.

Additionally, long-term occupants are more likely to invest in conservation than short-term occupants since they can anticipate seeing an actual pay-back. Over 65 percent of Nova Scotians have lived in their current homes for five years, compared with a Canadian average of 59 percent.

FIGURE 2-7 NOVA SCOTIA: END-USE ENERGY CONSUMPTION
1979-84
RESIDENTIAL SECTOR



Source: Nova Scotia Department of Mines and Energy

The potential for energy conservation in the residential sector is largely found in three categories: behavioural changes; improved insulation and air infiltration reduction; and heating and water heating efficiency. A 1983 report by Canertech on the potential of increased energy efficiency estimated the relative annual energy savings in Canada for each of these categories relative to total 1979 space heating costs as follows:

Table 2-7

ANNUAL ENERGY SAVINGS IN CANADA

	Ultimate Potential as of '72	Achieved 1972-82	Remaining Potential as of '83	Economic Remaining Potential
Behavioural Changes	10%	8%	2%	2%
Insulation and Comprehensive Airtightening	40%	6%	34%	10%
Equipment	15%	0%	15%	6%
TOTAL	65%	14%	51%	18%

Source: Canertech, p. 21

Behavioural changes include such actions as reducing room temperatures, thermostat setback during unoccupied or sleeping periods, and reducing the volume of hot water used and the temperature of hot water storage. On a macro-level, it also encompasses such societal trends as changes in household size.

Insulation reduces conductive heat loss and three separate areas of the house are considered for insulation: attics/roofs, walls and basements. Air-tightening measures can eliminate the loss of heat by the infiltration of cold air and the exfiltration of warm air. It can include upgrading windows, weatherstripping and interior insulation (such as floors above unheated areas). Air infiltration is also heavily affected by factors not within the owner's control such as wind velocity and the workmanship of the original homebuilder.

Heating equipment in residential units is normally used for either space heating or hot water heating. Energy could be conserved by more efficient heating units (fuel combustion), and improved heat distribution systems including water tank and pipe insulation.

A study done by the Nova Scotia Department of Mines and Energy concluded that potential savings in the residential sector are as summarized in Table 2-8. "Realistic Savings" assumes that householders will adopt only those measures with short paybacks and will not be amenable to lifestyle changes. It assumes most homeowners would be motivated to act on measures offering a positive return if the right combination of information and technical services were offered. "Maximum Savings" could be achieved if energy efficiency was the only objective and neither cost-effectiveness nor aversion to change were barriers.

Table 2-8

POTENTIAL SAVINGS SUMMARY
NOVA SCOTIA RESIDENTIAL SECTOR

	Realistic Savings	Maximum Savings
Insulation	14.3%	27.5%
Air Leakage Reduction	5.0%	10.0%
Sub-Total	19.3%	37.5%
Heating Systems (reduced by heat loss savings)	6.5%	9.4%
Domestic Hot Water	3.0%	4.0%
TOTAL SAVINGS	28.8%	50.9%

Source: Nova Scotia Department of Mines and Energy

The total "Realistic Savings" (28.8 percent) is higher than the Canertech "Economic Remaining Potential" (18 percent) because, relative to the national average, Nova Scotia has more owner-occupied buildings, an older housing stock, different construction techniques, longer average duration of tenure and higher energy costs.

Industrial and Commercial/Institutional Sectors

Table 2-9 and Figure 2-8 present historical energy use in the commercial/institutional and industrial sectors.

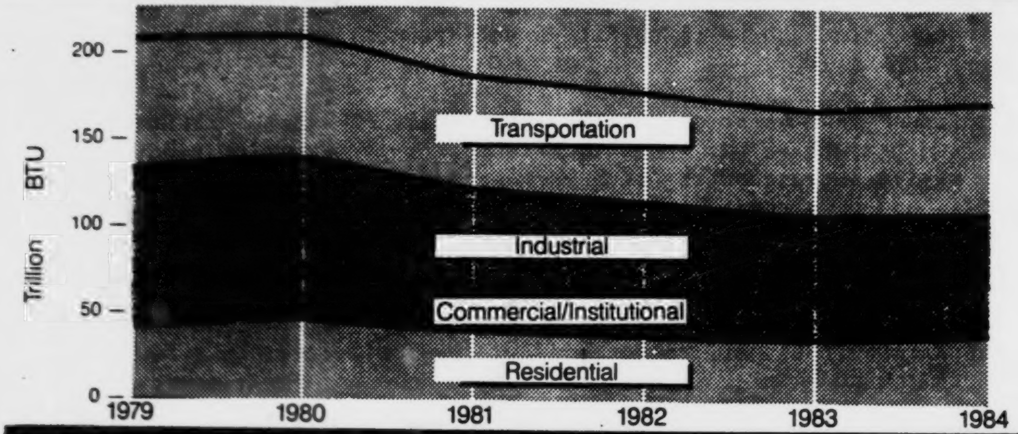
Table 2-9

INDUSTRIAL, COMMERCIAL AND INSTITUTIONAL ENERGY USE
1979 and 1984
(trillion Btu)

	Industrial		Commercial/ Institutional	
	1979	1984	1979	1984
BY FUEL				
Coal	0.6	1.2	0.0	0.1
Coke	11.5	3.4	0.0	0.0
Coal Gas	4.1	0.0	0.0	0.0
Electricity	8.8	8.5	5.2	6.6
Steam	16.4	7.8	0.2	0.3
Wood	2.1	5.1	0.0	0.0
Motor Gas	1.5	0.4	0.4	0.6
Light Fuel Oil	2.4	2.8	6.7	8.3
Heavy Fuel Oil	14.8	8.0	6.9	5.2
Diesel	3.3	5.1	1.6	3.7
Kerosene	0.1	0.1	0.5	0.3
LPG (Propane)	0.4	0.4	0.6	0.8
Aviation Gas	0.0	0.0	1.0	1.8
TOTAL USE	66.0	42.8	23.1	27.7
Refined Petroleum Products Percentage	34%	39%	77%	75%
GDP ($1971 millions)	762	916	1692	2149
Btu/$1 GDP	86,614	46,724	13,652	12,890
Percentage of Total Provincial Use	32%	26%	12%	17%

Source: Nova Scotia Department of Mines and Energy

FIGURE 2-8 NOVA SCOTIA: END-USE ENERGY CONSUMPTION 1979-84
INDUSTRIAL AND COMMERCIAL/INSTITUTIONAL SECTORS



Source: Nova Scotia Department of Mines and Energy

Because of the more complex and diverse nature of these sectors, there is less information about the existing stock. The institutional sector will be largely surveyed by the Provincial Energy Assessment Program (PEAP) program, but the data are not yet available.

Factors affecting energy management in these sectors include the level of production; the scheduling of operations; awareness and motivation of staff with respect to energy conservation and building maintenance; and the size and level of both administrative and energy management expertise of the operation. As with the residential sector, building tenants react differently than building owners, and rented buildings tend to be less often retrofitted because of the split responsibility for energy costs. Financial barriers are particularly critical, especially since in recent years short-term cash flow considerations have tended to override potential long-term savings.

Differences do exist between the various sectors. Industrial energy consumption is particularly affected by the level and scheduling of production. Buildings are generally designed for production efficiency rather than energy efficiency. Production energy use is generally well understood and reasonably controlled, and the systems are regularly maintained, repaired and upgraded. Building-related energy uses and systems may not be as well understood or maintained.

The commercial sector tends to put more emphasis on building comfort and aesthetics. Level of output is less important than hours of operation, which must be maintained regardless of business volume. Financial considerations are particularly critical in the commercial sector, and attitudes towards conservation less favourable than in either of the other sectors. Effective control over . energy consumption is often at a relatively low level of management. Maintenance tends to be on an "as needed" rather than a preventive or conservation basis.

Institutions tend to be similar to the commercial operations in many ways. On the whole, attitudes towards energy conservation tend to be more positive because of the long-term nature of the facilities, fixed budgets, and high energy consumption. The high consumption level can be attributed to low-cost construction, the age of the systems, and the limited repair budgets.

To date, operations utilizing approximately 26 percent of the commercial/institutional sector energy consumption and about 55 percent of the industrial sector consumption have had their energy use analyzed through a mix of federal and provincial programs.

The commercial/institutional sector provides the largest potential for further savings both because of the lower degree of analysis and action taken to date, and because the energy users in the commercial sector in particular are less concerned with energy efficiency. Professional estimates indicate that sectoral consumption could be reduced by about 20 percent in ideal conditions.

Overall, the industrial sector already tends to be a more efficient energy user than either the commercial or institutional sectors. Energy use is also more closely tied to production than in any other sector. Ideally, energy use could be reduced by about 16 percent. Since the industrial sector accounts for approximately half again as much energy consumption as the commercial/institutional sector, the potential gains are substantial.

Transportation Sector

Table 2-10 and Figure 2-9 present energy use in Nova Scotia's transportation sector between 1979 and 1984.

Road transport accounts for almost 70 percent of energy consumption in the transportation sector, and almost one-quarter of total provincial use in 1984. Since road transport is also the transportation mode most amenable to provincial initiatives, it becomes the obvious focus for future initiatives.

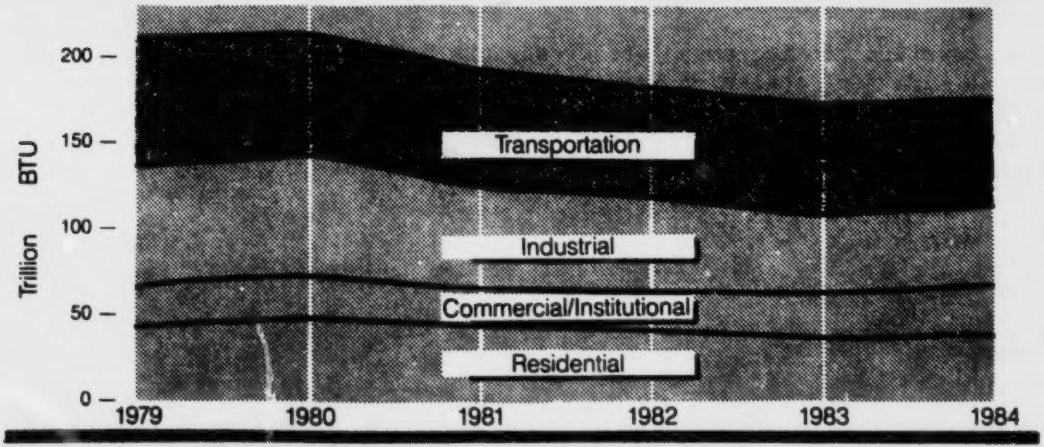
Table 2-10

TRANSPORTATION ENERGY USE BY FUEL TYPE AND USE
1979 and 1984
(trillion Btu)

	1979	1984
BY FUEL		
Motor Gas	39.6	36.0
Diesel	15.4	14.4
Heavy Fuel Oil	9.3	3.6
Aviation Gas	3.6	3.3
LPG	0.0	0.2
TOTAL	67.9	57.5
BY USE		
Sea	14.6	10.0
Road	46.8	41.6
Railway	2.9	2.6
Air	3.6	3.3
TOTAL	67.9	57.5
Refined Petroleum Products Percentage	100.0%	100.0%
Vehicle Registrations		
Passenger	327,306	298,824
Commercial	133,925	131,525
Other	81,778	78,016
Total Registrations	543,009	508,365
Btu(millions)/ Vehicle(Road)	86	81
Percentage of Total Provincial Use	34%	34%

Source: Nova Scotia Department of Mines and Energy

FIGURE 2-9 NOVA SCOTIA: END-USE ENERGY CONSUMPTION 1979-84
TRANSPORTATION SECTOR



Source: Nova Scotia Department of Mines and Energy

A 1980 estimate distributed road transport energy consumption as shown in Table 2-11. With some caution, this can be used as an indicator of where conservation efforts might be most rewarding.

Table 2-11

1980 ESTIMATED DISTRIBUTION OF FUEL
USED FOR ROAD TRANSPORTATION
(Thousands of Gallons)

PERSONAL USE		COMMERCIAL USE	
Automobile	148,545	Automobile	10,053
Truck	23,757	Taxi	9,327
		Local Truck	59,018
		Linehaul Truck	44,478
		Bus	2,266

Personal Use Sub-Total	172,302
Commercial Use Sub-Total	125,142
TOTAL	297,444
Of Which	
Urban	20%
Suburban	26%
Rural	54%

Source: Nova Scotia Department of Mines and Energy

The energy efficiency of the stock should continue to improve since the average passenger vehicle lasts 10 years in Nova Scotia, and older, less fuel efficient cars are still being replaced by new models. However, the U.S. government is retaining its current "Fleet Mileage Standard" of 33 mpg (Imperial), so there will be less pressure for auto manufacturers to continue improving fuel consumption to the same degree as in the past five years.

Other barriers to increased efficiency are being addressed through improved traffic operation in urban areas. This includes improved signal timing, flashing traffic signals, widening of intersections, one-way street systems and reversible lanes and selective removal of street parking.

Perhaps the biggest opportunity for efficiency gains is in the attitudinal and information area. Ride-sharing programs, staggered working hours and a better understanding of the advantages of fuel efficiency by truckers could have major benefits.

Programs directed at urban/suburban areas would seem to have the most significant energy management potential in the road transport sector. Urban areas have the highest concentrations of passenger and commercial vehicles, both because of their population and role as employment nodes. They have the highest potential for conservation initiatives requiring an initial capital outlay, such as new transit concepts or technological improvements in traffic management. Urban driving, because it is much less efficient than highway driving, also offers higher energy savings from changes in attitudes or driving habits.

Overall, it is estimated that a feasible conservation program for road transport could reduce the total consumption of the transportation sector by ten percent.

2.3 THE STATUS QUO CASE

Introduction

In 1984, the Nova Scotia Department of Mines and Energy with assistance from the federal government undertook a major effort to develop a sophisticated energy demand forecasting system. Three components were produced: an econometric energy demand forecasting model, an end-use/engineering energy demand forecasting model and a comprehensive energy data base covering, on average, 20 years of historical data. The energy demand forecasts presented in this document were compiled through the use of these three tools.

The econometric model consists of two sub-components: a regional economic module and an energy demand module. The regional economic module deals with macro-economic and demographic factors such as gross domestic product, labour force size, employment levels and consumer expenditure. The energy demand module combines the economic and demographic conditions projected by this regional model with price forecasts, and translates the results into energy requirements based on past relationships between price, economic activity and consumption.

The end-use/engineering model forecasts energy demand through the use of a sectoral summation of energy consumers, energy consuming capital stock and energy use by type of equipment. Choices between competing fuels are made on the basis of capital and operating costs over a five year period.

The two models have different characteristics and uses. The econometric model is best suited for estimating changes in energy demand in response to economic and demographic growth and energy price changes (both in real and relative terms). It is most effective in forecasting over the short to medium term. Because it is constructed on the basis of historical relationships, it becomes less reliable in the longer term since changes in capital stock and technology alter such relationships.

In contrast, the end-use/engineering model is best for estimating long term changes in energy consumption patterns, since technological change and replacement of capital stock can be factored into the forecast. Because it is based on technical estimates, however, it deals less well with future behavioural change.

The two models will tend to produce different results. They can be used independently or together, with appropriate weightings depending upon the forecast period under consideration. The "status quo" forecast results from combining the output of the two models, a combination which recognizes the appropriate strengths and weaknesses of each methodology.

Both forecasting models require exogenous data to enable them to produce estimates of future consumption. Where possible, actual historical data were employed. The remaining information had to be estimated from various sources. National and international forecasting agencies were relied upon for such data as world oil price forecasts. Data on local issues such as anticipated energy conservation are available from provincial government and industry sources. Anticipated changes in energy supplies available to the province such as natural gas can be determined from energy industry documents.

Philosophy and Description of the Status Quo Case

The status quo case is designed to estimate provincial energy consumption trends which would result if the provincial government took no further action with respect to energy demand and supply. Energy supply and demand within the province are assumed to respond to national and international economic conditions which are not always optimal for Nova Scotia. More specifically, the status quo case assumes that the province does not:

* take any initiative to stimulate development of indigenous energy resources;

* encourage the use of new fuel production and utilization technologies; or

* promote or advise on conservation opportunities.

The purpose of the scenario is to identify which supply and demand trends would emerge if the province took no further initiatives. This forecast incorporates, as its foundation, very specific forecasts relating to economic activity in the province, demographic factors and, of course, energy prices. The detailed assumptions underlying the status quo energy demand forecast are contained in Appendix B.

This forecast incorporates, as its foundation, very specific forecasts relating to economic activity in the province, demographic factors and, of course, energy prices. Detailed assumptions underlying the status quo energy demand forecast are contained in Appendix B.

In general, the forecast is based on a crude oil price outlook which projects the world price of crude oil at (US)$28 per barrel in 1986, increasing only at the rate of inflation until 1990 and by one percent real per annum after 1990. As a result of this crude oil forecast, Nova Scotia's petroleum product prices are expected to increase in line with crude oil prices; electricity and coal prices are forecast to increase only with inflation; and natural gas prices to consumers are forecast to be discounted against fuel oils as they are at present in central Canada.

The status quo forecast also includes the production of offshore gas and associated liquids from the Venture Gas Project. However, distribution of that gas to customers in Nova Scotia will be confined to those areas along the main transmission line, with availability of gas limited to 20 MMcf/day for the Maritimes as other production is exported. The coal mining industry is expected to reach a peak production of 5.14 million short tons in 1993. Conservation measures will be employed to a certain extent by all sectors, reflecting the impact of previous government programs in this area and the continuation to their expiry date of programs which are now in operation.

The province's gross provincial product (GPP) has been forecast to increase at an average annual rate of 2.4 percent per year between 1985 and 2005 reflecting, along with other activities, the impact of the development of offshore gas. Population is forecast to increase by 0.5 percent per year.

It is believed that the price, economic and demographic forecasts employed represent "middle of the range" estimates of these variables. The resultant energy demand forecast should be indicative of the demand trends which will emerge under a moderate growth and price scenario.

Sectoral Energy Demand Forecasts

This section presents the status quo end-use energy demand forecasts for the residential, commercial/institutional, industrial and transportation sectors. The term end-use energy pertains to the consumption of energy by the ultimate consumer. Energy resources which are converted to another form, such as coal to coke or heavy fuel oil to electricity, are reported in their final form (coke and electricity).

The forecast presents 1984 energy consumption data and forecasts for the period 1985 to 2005. All demand is reported in trillion of Btu.

Residential Sector

The residential sector includes all types of dwelling units: single detached homes, duplexes, row houses, apartments and seasonal residences.

Forecast end-use energy requirements in the residential sector are based on the assumption that total housing stock will increase at an annual compound rate of 1.9 percent. The demand forecast is presented in Table 2-12 and Figure 2-10. Total energy use is expected to grow from 37.8 trillion Btu in 1984 to 49.6 trillion Btu in 2005. Continuing conservation in the residential sector, as well as the increased efficiency of newly constructed dwellings and combustion equipment, will account for the decreasing average energy consumption per dwelling and an annual compound growth rate in energy use of 1.3 percent.

Table 2-12

STATUS QUO CASE: RESIDENTIAL END-USE ENERGY DEMAND
(trillion Btu)

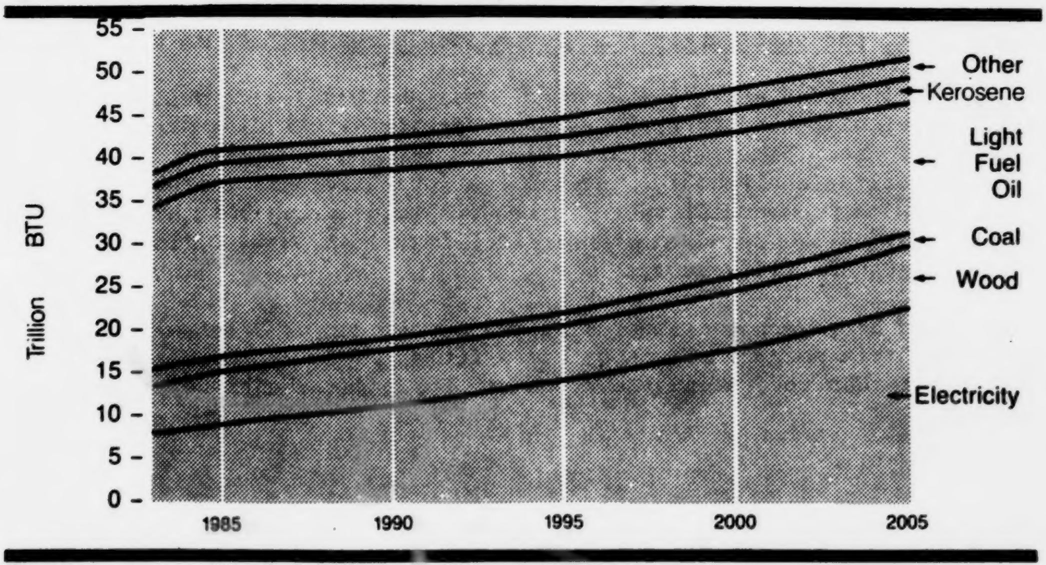
	1984	1990	1995	2000	2005
Electricity	8.4	10.7	13.4	17.1	21.5
Biomass	5.8	5.9	6.1	6.5	7.1
Coal	1.4	1.4	1.4	1.4	1.4
LFO	18.2	18.6	17.4	16.1	14.5
Kerosene	2.1	2.3	2.3	2.3	2.3
Other*	2.0	1.3	2.4	2.8	2.8
TOTAL	37.8	40.2	43.0	46.2	49.6

* includes hfo, solar, propane, natural gas.

Source: Nova Scotia Department of Mines and Energy

Electricity is expected to show the strongest growth in residential market share, increasing from 8.4 trillion Btu in 1984 to 21.5 trillion Btu in 2005, or from 22.1 percent to 43.4 percent in total end-use. Electrical baseboard space heating systems are expected to remain attractive with building contractors, as is the price of electricity compared to light fuel oil. As such, electricity is anticipated to capture the majority of the space heating market for new construction until natural gas becomes available. Even after gas availability, the gas service area does not seriously dampen the growth in overall provincial demand for electricity.

FIGURE 2-10 STATUS QUO CASE: RESIDENTIAL END-USE ENERGY DEMAND, 1984-2005



Source: Nova Scotia Department of Mines and Energy

Biomass (wood) is expected to remain a popular space heating alternative, especially in rural areas. Low acquisition costs are expected to drive the continuing demand for wood as it increases from 5.8 trillion Btu in 1984 to 7.1 trillion Btu in 2005, maintaining its market share at approximately 15 percent.

As expected, light fuel oil will be the victim of the growth in popularity of electricity, natural gas and wood. Long-term real increases in oil prices will continue to steer new construction to other forms of energy, as well as cause existing consumers of oil to re-evaluate their position when stock replacement time arrives. Additionally, there will be continuing conservation in older homes, the majority of which consume oil.

Natural gas, introduced in 1991, is expected to account for 0.8 trillion Btu in 2005, or 1.5 percent of the residential energy market. The limited distribution area resulting from constrained supplies accounts for the relatively low market share in the short-term.

Demand for coal is expected to remain constant at the 1.4 trillion Btu level. Difficulties in transporting the coal to regions distant from the mines, as well as handling and storage problems associated with its use, are expected to limit the popularity of coal in residential use.

Demand for kerosene/stove oil and propane is also expected to remain at close to current levels. Stove oil will face the same market pressures as light fuel oil, but kerosene should remain popular as a source of secondary or back-up space heat. Price will discourage increased use of imported propane as a space and water heating alternative.

The use of wind and solar energy is expected to continue but will not exceed 0.1 trillion Btu. The economies of small-scale residential systems will continue to discourage their widespread use.

Commercial/Institutional/Public Administration Sector

This sector includes all wholesale and retail businesses as well as federal, provincial and local government services (including hospitals, schools and other institutions). With one exception, the commercial/institutional/public administration sector (hereafter referred to as the commercial sector) includes major group 50 through major group 99 of the Standard Industrial Classification (SIC) issued by Statistics Canada (1980 version).

All fuels used by government (including the Department of Defense) are included in this sector. Transportation fuels used by commercial vehicles other than government are accounted for under the transportation sector.

Total energy use is forecast to increase from 27.6 trillion Btu in 1984 to 41.7 trillion Btu in 2005, a compound annual increase of 2.0 percent (see Table 2-13 and Figure 2-11). This results primarily from an anticipated annual growth in the economy of 2.4 percent over the same period and an associated increase in personal disposable income of 3.1 percent. Offsetting these upward pressures will be a relatively low increase in government expenditure (1.0 percent annually) and continuing conservation in existing establishments, as well as more energy conscious construction of new facilities.

Table 2-13

STATUS QUO CASE: COMMERCIAL END-USE ENERGY DEMAND FORECAST
(trillion Btu)

	1984	1990	1995	2000	2005
Electricity	6.6	7.8	9.4	11.2	13.0
HFO	5.2	8.6	8.9	9.2	9.5
LFO	8.3	9.6	9.0	8.2	7.6
Diesel	3.7	4.5	5.0	5.7	6.3
Aviation Gas	1.8	1.9	2.0	2.1	2.2
Other*	2.0	2.3	2.9	3.1	3.2
TOTAL	27.6	34.7	37.2	39.5	41.8

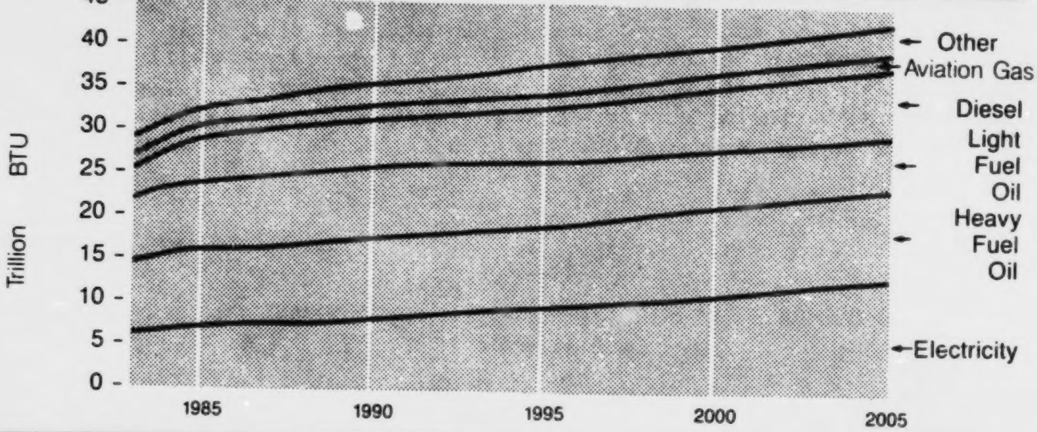
* includes propane, kerosene, motor gas, coal, steam, natural gas, solar

Source: Nova Scotia Department of Mines and Energy

As was the case with the residential sector, electricity is expected to show the largest increase in market share, from 23.9 percent in 1984 to 31.1 percent in 2005 (an increase from 6.6 trillion Btu to 13.0 trillion Btu). Attractive pricing versus oil and technical suitability should continue to provide the impetus behind growth in electricity demand for space heating and process power particularly in new construction. Because of the limited natural gas distribution area, the penetration of electricity on a province-wide basis will not be seriously affected.

Natural gas should account for 1.8 percent of commercial energy demand by 2005. Attractive pricing, particularly when compared to oil, should ensure local growth in new construction after 1991, as well as penetration into existing commercial establishments using oil. However, the supply of gas to the domestic market will determine overall penetration.

FIGURE 2-11 STATUS QUO CASE: COMMERCIAL/INSTITUTIONAL END-USE ENERGY DEMAND, 1984-2005



Source: Nova Scotia Department of Mines and Energy

Heavy fuel oil use should continue to increase from 5.2 trillion Btu in 1984 to 9.5 trillion Btu in 2005. Heavy fuel oil use will be unavoidable, particularly in larger facilities, such as hospitals, for which no practical alternative is available.

Light fuel oil should again account for most of the market share loss. Competition from electricity and natural gas, as well as continuing conservation efforts in older establishments should all contribute to reduce light fuel oil's market share from 29.9 percent in 1984 to 18.2 percent in 2005.

The demand for diesel oil by government vehicles should show an increase, primarily in the vehicle fleet market. By comparison, gasoline demand should remain relatively constant. As older inefficient gasoline-fuelled vehicles are replaced, the increased fuel efficiency of the new stock should offset a growth in the number of vehicles. Diesel vehicles, by contrast, will not see such a significant change in efficiency between old and new stock and, as a consequence, demand should increase with increasing numbers of units.

Propane should continue to show growth in market share, particularly in areas not served by natural gas, largely because its clean-burning characteristics make it an ideal fuel for facilities such as restaurants and laundries.

Aviation gasoline and turbo fuel will increase from 1.8 trillion Btu in 1984 to 2.2 trillion Btu in 2005. Fuel use is dominated by Department of Defense ships and aircraft. The modest rate of growth reflects the level of government spending related to defense as well as the increased efficiency of new stock.

Coal, kerosene/stove oil and steam are not expected to show any large increase in market share. Handling and transportation problems will limit coal's share of the market. The Nova Scotia Power Corporation is not expected to provide any off-system sales of steam, except those currently provided from the Water Street Plant in Halifax. Stove oil will face competitive pressures from electricity and natural gas, as will light fuel oil.

As was the case in the residential sector, solar and wind are expected to account for less than 0.1 trillion Btu. Again, their use is limited by currently unfavourable economies.

Industrial Sector

The industrial sector covers the forestry (wood harvesting), mining, fishing (processing only), manufacturing, agriculture and construction industries. It is consistent with major groups 1 through 44 in the SIC codes published by Statistics Canada, except for the exclusion here of fuels used by fishing vessels (found under the transportation sector).

Demand for energy in the industrial sector is expected to increase from 42.9 trillion Btu in 1984 to 60.4 trillion Btu in 2005, an average annual increase of 1.6 percent (see Table 2-14 and Figure 2-12). Leading the increase in energy demand is the expected growth in manufacturing where Real Domestic Product (RDP) is expected to grow by 3.8 percent annually. The remaining industries also show real growth but not to the same extent. Offsetting the effect of the growth in RDP is the shutdown, in mid-1985, of the heavy water plants, which accounted for more than 20 percent of total energy demand in the industrial sector. Additionally, conservation in existing facilities and the increased energy efficiency of new facilities, will lower average energy used per unit of output.

Table 2-14

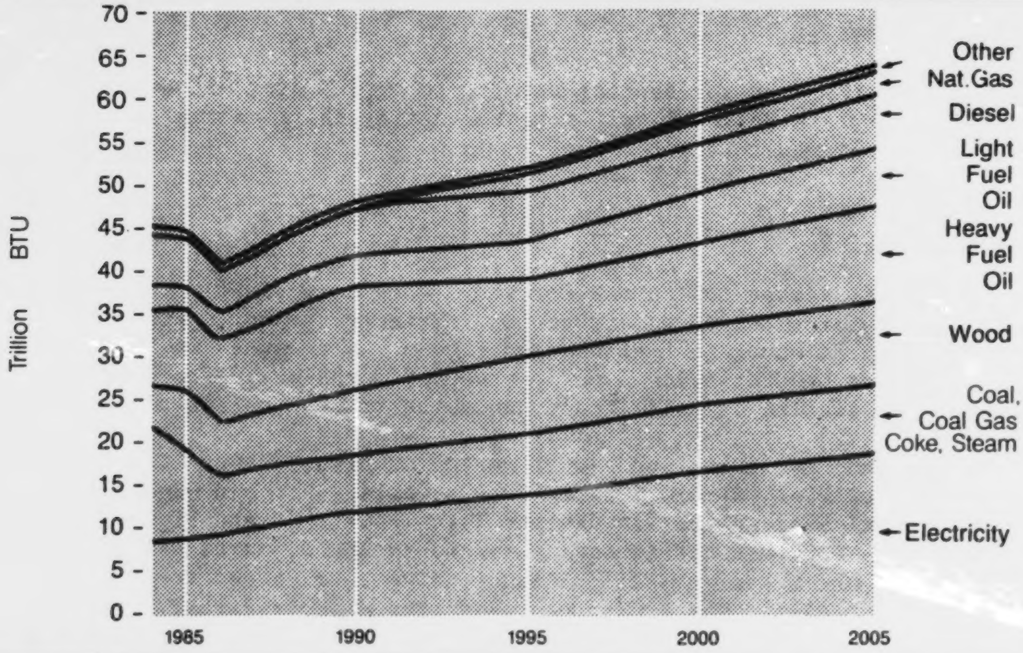
STATUS QUO CASE: INDUSTRIAL END-USE ENERGY DEMAND
(trillion Btu)

	1984	1990	1995	2000	2005
Electricity	8.5	11.9	13.3	15.8	17.9
Coal*	12.4	6.2	6.6	7.1	7.6
Biomass	5.1	7.4	8.6	8.9	9.0
HFO	8.0	10.7	8.1	8.9	10.4
LFO	2.8	3.6	4.4	5.7	6.7
Diesel	5.1	5.3	5.4	5.5	5.6
Natural Gas	0.0	0.0	2.4	2.4	2.4
Other**	1.0	0.7	0.7	0.7	0.8
TOTAL	42.9	45.8	49.5	55.0	60.4

* includes coal, coal gas, coke, steam
** includes kerosene, propane, motor gas

Source: Nova Scotia Department of Mines and Energy

FIGURE 2-12 STATUS QUO CASE: INDUSTRIAL END-USE ENERGY DEMAND, 1984-2005



Source: Nova Scotia Department of Mines and Energy

As with the residential and commercial sectors, electricity is forecast to show the largest growth rate, with its market share rising from 19.8 percent in 1984 (8.5 trillion Btu) to 29.7 percent in 2005 (17.9 trillion Btu). Pricing provides the major incentive for growth in electricity demand, but the move away from traditional "smokestack" industries to less energy intensive manufacturing will also have an effect.

Forest biomass will remain popular, particularly in the wood processing industries. In addition, low cost access to chipped wood should also allow other small industrial facilities to make use of biomass as more efficient handling and combustion systems become available. Forest biomass demand is expected to increase from 5.1 trillion Btu in 1984 to 9.0 trillion Btu in 2005.

Diesel oil is expected to remain popular, particularly for fuelling generators in the construction industry. The tendency for new farm tractors to be fuelled with diesel oil will add to a growth in use, while at the same time causing gasoline sales to decrease from 0.4 trillion Btu to 0.2 trillion Btu. Diesel sales are expected to climb from 5.1 to 5.6 trillion Btu in 2005.

Coal use is expected to grow from 1.2 trillion Btu in 1984 to 3.1 trillion Btu in 2005. The low cost of coal relative to oil, as well as new handling and combustion techniques such as coal/liquid mixtures are expected to make coal an attractive alternative to heavy fuel oil in both the new construction and replacement markets.

Natural gas consumption is expected to grow to 2.4 trillion Btu by 2005, largely as a substitute for heavy fuel oil in the new construction and replacement markets. Gas penetration will be determined by price, supply and the distribution area.

Heavy fuel oil use will increase from 8.0 trillion Btu in 1984 to 10.4 trillion Btu in 2005. Despite competitive pressures from electricity, coal and natural gas, heavy fuel oil will continue to find a market in areas outside the gas distribution areas where coal and electricity do not provide a technically suitable alternative.

Light fuel oil use is also projected to increase, from 2.8 trillion Btu in 1984 to 6.7 trillion Btu in 2005, due to the technical unsuitability of electricity as a heating and process fuel in certain applications and the availability of gas.

Propane and kerosene consumption should remain close to present levels, which are relatively insignificant. The application of industrial-scale wind and solar power is also projected to remain at the present level of less than 0.1 trillion Btu due to the economics of existing technology.

Steam demand decreased to zero from 7.8 trillion Btu when the heavy water plants closed in mid-1985.

Transportation Sector

The transportation sector generally includes all transportation and communications-related fuels. More specifically, it includes major groups 45 through 49 inclusive of Statistics Canada's SIC codes, with one exception: fuels used by fishing vessels are included here in the transportation sector rather than the industrial sector.

Total energy demand in the transportation sector is anticipated to increase from 57.5 trillion Btu in 1984 to 75.4 trillion Btu in 2005, an average annual increase of 1.3 percent (see Table 2-15 and Figure 2-13). The upward influence in demand provided by a relatively robust economy will be tempered by the gradual replacement of inefficient older stock in all categories of transportation, resulting in a slower rate of increase than is suggested by economic conditions alone.

Table 2-15

STATUS QUO CASE: TRANSPORTATION END-USE ENERGY DEMAND
(trillion Btu)

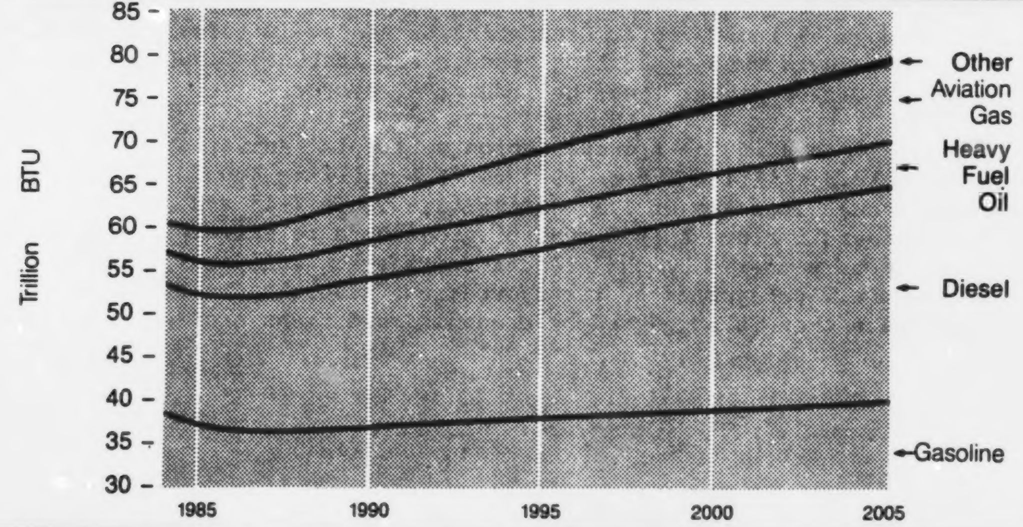
	1984	1990	1995	2000	2005
Gasoline	36.0	35.0	35.7	36.3	37.0
Diesel	14.4	16.1	19.1	21.9	24.9
HFO	3.6	3.9	4.4	4.6	4.9
Aviation Gas	3.3	4.8	6.2	7.3	8.4
Other*	0.2	0.2	0.2	0.2	0.2
TOTAL	57.5	60.0	65.6	70.3	75.4

* includes propane

Source: Nova Scotia Department of Mines and Energy

Diesel fuel use is expected to increase from 14.4 trillion Btu in 1984 to 24.9 trillion Btu in 2005, an increase in market share from 25.0 percent to 33.1 percent. A continued reliance on diesel railway locomotives and fishing vessels will provide increased demand as will the overall increase in the number of diesel-powered road vehicles. When compared to gasoline, diesel vehicles will show a smaller overall increase in combustion efficiency. The retirement of old stock will not completely offset an increase in demand due to increasing vehicle numbers.

FIGURE 2-13 STATUS QUO CASE: TRANSPORTATION END-USE ENERGY DEMAND, 1984-2005



Source: Nova Scotia Department of Mines and Energy

Gasoline on the other hand is expected to show only marginal growth in demand (36.0 to 37.0 trillion Btu), and a resulting decrease in market share from 62.7 percent to 49.1 percent. Almost all gasoline demand in this sector is accounted for by retail sales to automobiles, and the gains in combustion efficiency through retirement of old stock are expected to offset increased demand from growing vehicle stock until 1990. Beyond that date, demand is expected to grow by 0.4 percent per year as the effects of increased efficiency begin to decline.

Heavy fuel oil use as a marine bunker is expected to increase from 3.6 trillion Btu in 1984 to 4.9 trillion Btu in 2005. The continuing popularity of Halifax among shipping lines, as well as the attractive bunkering options available in Cape Breton, will provide the impetus to heavy fuel oil demand increases.

Aviation gas/turbo fuel is expected to increase from 3.3 trillion Btu in 1984 to 8.3 trillion Btu in 2005, reflecting the increasing popularity of air transport for both passengers and freight.

The use of propane as a vehicle fuel in Nova Scotia is a relatively new technology. Assuming current conditions remain unchanged, the demand for propane as a vehicle fuel is not expected to exceed 0.2 trillion Btu throughout the forecast period.

Total End-Use Energy Demand

Table 2-16 and Figure 2-14 present the province's total end-use energy demand as forecast for the status quo assumptions, broken down by fuel type. Total end-use energy demand is expected to increase from 165.8 trillion Btu in 1984 to 227.1 trillion Btu in 2005 (excluding producer consumption and use for non-energy products). This represents an annual growth rate of 1.5 percent.

Table 2-16

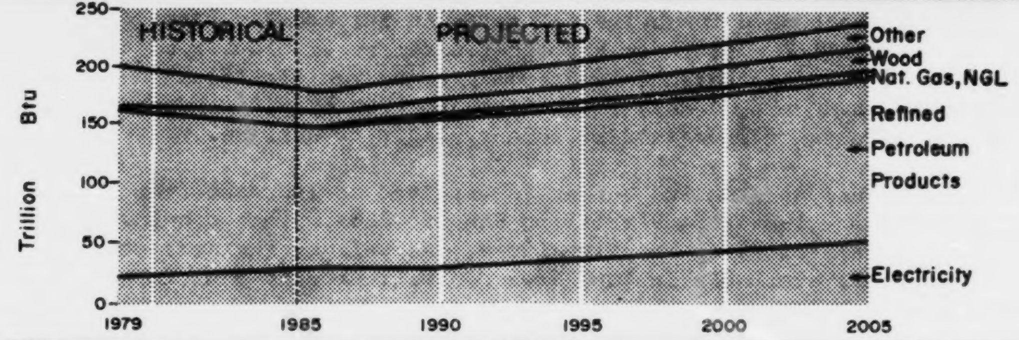
STATUS QUO CASE: TOTAL END-USE ENERGY DEMAND
(trillion Btu)

	1984	1990	1995	2000	2005
Electricity	23.4	30.3	36.0	44.1	52.4
RPP	117.4	129.0	132.4	138.7	145.3
Natural Gas, NGL	0.0	0.0	3.4	3.9	3.9
Biomass	10.9	13.3	14.7	15.5	16.1
Other*	14.1	8.0	8.5	8.9	9.4
TOTAL	165.8	180.6	195.0	211.1	227.1

* includes coal, coke oven gas, steam, coke, solar

Source: Nova Scotia Department of Mines and Energy

FIGURE 2-14 STATUS QUO CASE: TOTAL END-USE ENERGY DEMAND, 1979-2005



Source: Nova Scotia Department of Mines and Energy

Electricity accounts for the largest increase, rising from 23.4 trillion Btu in 1984 to 52.4 trillion Btu in 2005, or from 14.1 percent to 23.1 percent of total demand. A Nova Scotia Power Corporation expansion plan to meet such increases includes adding a 0.5 megawatt hydro plant in Fall River in 1986, a 150 megawatt coal-fired thermal plant in 1988, and six 300 megawatt coal-fired thermal plants between 1990 and 2005.

In contrast to electricity, refined petroleum products increase from 117.4 trillion Btu to only 145.3, with their market share dropping from 70.8 percent to 64.0 percent. Steam declines markedly, reflecting the closing of the heavy water plants, and natural gas comes onstream in 1990, climbing to 3.9 trillion Btu by the close of the forecast period.

Primary Energy Demand

Primary energy refers to the total amount of energy available from a natural resource (including conversion losses). Primary fuel sources are those either consumed directly or converted to another energy form, such as coal into electricity. Primary energy sources generally include coal, crude oil, natural gas, natural gas liquids, hydro-derived electricity, geothermal steam and all forms of renewable energy. By converting demand for end-use energy into demand for primary fuels, energy demand can be related to the province's ability to produce its own energy resources. What cannot be produced within the province must be acquired on national and international markets. Similarly, surpluses are available for future use or export.

To convert end-use energy demand to primary energy demand, several calculations are necessary. Demand for electricity which cannot be produced by hydro power must be translated into demand for thermal coal and oil products required by thermal generating stations. These are then converted into primary demand for coal and crude oil. Likewise, demand for oil products must be converted into demand for crude oil. Finally, demand for coke and coke oven gas must be converted into demand for coking coal.

Demand for coal and refined petroleum products necessary to generate the required levels of thermal electricity was calculated by the Nova Scotia Power Corporation based on the generation expansion plan resulting from the electricity demand forecast. Demand for crude oil and/or pentanes plus was calculated by converting demand for all refined products through the use of the average refining efficiencies of Maritime oil refineries weighted by throughputs. Demand for primary coal other than for thermal electricity generation was estimated by adding producer consumption and metallurgical coal used for coke production to end use energy demand. Table 2-17 and Figure 2-15 shows the forecast demand for energy in its primary form, broken down by energy source.

Table 2-17

STATUS QUO CASE: TOTAL PRIMARY ENERGY DEMAND
(trillion Btu)

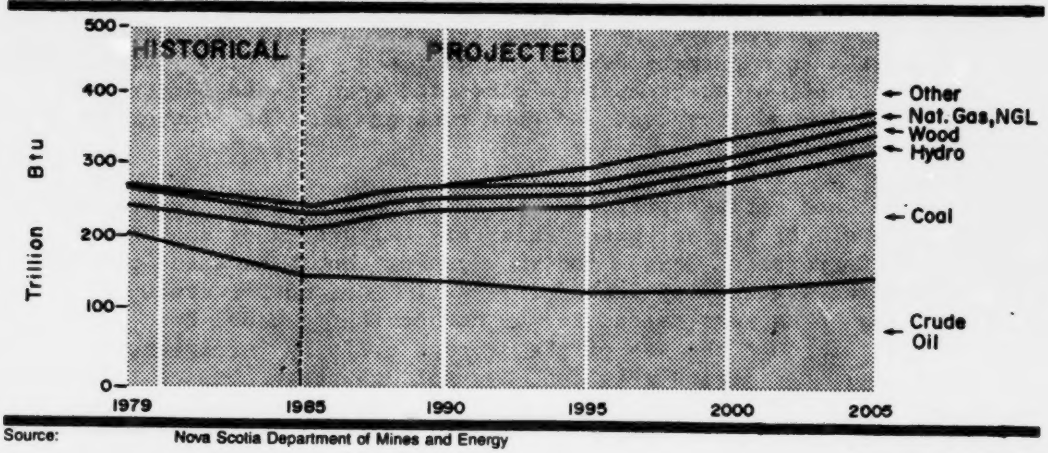
	1984	1990	1995	2000	2005
Crude Oil	147.4	144.7	130.1	134.7	148.7
Coal	61.7	88.8	111.4	142.4	170.7
Hydro	10.5	19.5	17.7	17.5	18.1
Biomass	10.9	13.3	14.7	15.6	16.1
Natural Gas, NGL	0.0	0.0	3.4	3.9	3.9
Other*	0.7	1.2	18.1	18.2	11.3
TOTAL	231.2	267.5	295.4	332.3	368.8

* includes msw, solar, wind, propane, pentanes plus

Source: Nova Scotia Department of Mines and Energy

The largest increase in demand occurs with coal, which is forecast to increase from 61.7 trillion Btu in 1984 to 170.7 trillion Btu in 2005, with a corresponding market share increase from 26.8 percent to 46.3 percent. The major reason behind this increase is the reliance by NSPC on coal-fired thermal generation for all incremental base load electricity production. This alone accounts for 102.1 trillion Btu of the 109.0 trillion Btu increase.

FIGURE 2-15 STATUS QUO CASE: TOTAL PRIMARY ENERGY DEMAND, 1979-2005



Source: Nova Scotia Department of Mines and Energy

Demand for wood will increase from 10.9 trillion Btu to 16.1 trillion Btu, although the market share of wood drops from 4.7 percent to 4.4 percent. Since end-use consumption of wood is identical to primary consumption, no conversion is required.

The province's consumption of hydro electricity (including imports) remains almost constant throughout the forecast period. This reflects the absence of new sites suitable for generating significant amounts of hydro electricity. River hydro will supply 4.9 percent of primary requirements by 2005.

The province's crude oil requirements are forecast to increase from 147.4 trillion Btu in 1984 to 159.0 trillion Btu in 2005. This latter figure includes 10.3 trillion Btu of pentanes plus which should be available from offshore gas development. The relatively small increase in demand for crude oil derivatives results from the competitive advantages of gas and electricity in all sectors except transportation. The market share of crude oil (including pentanes plus) is expected to drop from 63.9 percent in 1984 to 43.1 percent in 2005. Excluding pentanes plus, the proportion drops to 40 percent.

Natural gas and gas liquids will account for 1.1 and 0.3 percent respectively of primary energy requirements by 2005. This low penetration reflects the supply available to the province.

Municipal solid waste, wind and solar will account for less than 0.2 percent of primary demand by 2005.

Supply/Demand Balance

This section reviews the relationship between the provincial demand for primary energy and the provincial ability to supply that energy from indigenous resources as identified earlier in Part Two.

Coal

Projected coal production under the status quo case is shown in Table 2-18.

Table 2-19 indicates the supply/demand balance. Despite large coal reserves, the province would experience a shortfall in coal beginning in the year 2000, unless new mining capacity beyond that presently anticipated is brought on stream. If exports to other provinces are halted, the shortfall is 18.4 trillion Btu in 2000, and 46.7 trillion Btu in 2005. If exports to other provinces continue at the level anticipated in 1995 (9.7 trillion Btu), the shortfall grows to 28.1 trillion Btu in 2000 and 56.4 trillion Btu in 2005.

Table 2-18

COAL SUPPLY - SALEABLE TONS
(1,000 tons)

	1985	1990	1995	2000	2005
Lingan	1502	1521	1521	1521	1521
Prince	1102	992	992	992	992
Lingan-Phelan	121	1653	1653	1653	1653
Total CBDC	2725	4166	4166	4166	4166
Pioneer	110	110	110	0	0
Evans	60	60	60	60	60
Brogan	34	34	34	34	34
Selminco & Other	220	110	0	0	0
Novaco	66	0	0	0	0
New Mine	0	276	661	661	661
TOTAL SUPPLY	3215	4756	5031	4921	4921
Btu (trillion)	81.1	119.9	126.8	124.0	124.0

Source: Nova Scotia Department of Mines and Energy

Table 2-19

COAL SUPPLY/DEMAND*
(trillion Btu)

	1985	1990	1995	2000	2005
Produced	81.1	119.9	126.8	124.0	124.0
- Exported	16.3	28.8	6.2	0.0	0.0
+ Imported	0.5	0.5	0.5	18.4	46.7
- Inter-Prov.	1.2	2.8	9.7	0.0	0.0
- N.S. Demand	64.1	88.8	111.4	142.4	170.7

* excluding inventory changes

Source: Nova Scotia Department of Mines and Energy

Crude Oil

Since Nova Scotia has no domestic crude oil production, all crude oil and/or refined petroleum products must be imported until pentanes plus become available from the Venture development. The forecast begins supplementing crude requirements with pentanes plus by 1995, recognizing that the supply of pentanes plus is related to the level of gas production.

The model converts provincial demand for petroleum products directly into provincial crude oil requirements. In fact, this is not strictly accurate since the province imports some refined petroleum products as well as exporting some refined petroleum products to other parts of the Atlantic oil marketing region and abroad. By treating Nova Scotia as an individual unit, the forecast tends to ignore the fact that the Atlantic oil market is regional rather than provincial. However, the direct conversion of provincial end-use demand to crude oil requirements is the only effective way to make year to year comparisons.

Nova Scotia will probably not encounter significant problems importing either crude oil or refined petroleum products in the near term, particularly if Hibernia comes on-stream in the 1990s. An international emergency could, of course, seriously affect this scenario.

Natural Gas

Natural gas demand will escalate until the available supply of approximately 10 MMcf/day or 3.9 trillion Btu is reached. This constraint is inherent in the economics of the development, which require an immediate market for all gas production.

It would be impossible for the Maritimes to utilize the 320 MMcf/day available from the Venture project without an extensive petrochemical industry. The short-term outlook for primary petrochemicals precludes this as a possibility.

In addition, the United States' gas purchasers have indicated that the capital required to construct facilities within the United States cannot be committed unless a minimum of 300 MMcf/day is available for transmission.

This leaves 20 MMcf/day for the domestic market in the status quo case, although further gas developments as outlined in the "target" case would have a significant impact on future domestic availability.

The supply/demand balance for natural gas in the target case is forecast as follows (trillion Btu):

Table 2-20

NATURAL GAS: SUPPLY/DEMAND
(trillion Btu)

	1990	1995	2000	2005
Production	27.1	116.6	116.6	68.6*
Exports	27.1	110.0	109.5	61.5
Inter-Provincial	0.0	3.2	3.2	3.2
Domestic Consumption	0.0	3.4	3.9	3.9

* This is the production curve contained in the Venture Gas Project export application. The producers plan to bring on additional reserves to maintain production at 116.6 trillion Btu.

Source: Nova Scotia Department of Mines and Energy

Natural Gas Liquids

Table 2-21 shows the expected supply of and demand for the various natural gas liquids.

All production of pentanes plus is forecast to be used as a crude feedstock replacement in Maritime refineries.

The Venture development will produce more propane than required to displace imports from Alberta. It is not forecast to displace local refinery production. Excess propane is available for inter-provincial export.

Since Nova Scotia has no demand for butane, the entire production is forecast to be exported.

Table 2-21

NATURAL GAS LIQUIDS: SUPPLY/DEMAND
(trillion Btu)

	1990	1995	2000	2005
Pentanes Plus				
Production	0.6	17.5	17.5	10.3
Domestic Use	0.6	17.5	17.5	10.3
Propane				
Production	0.9*	3.6	3.6	2.1
Domestic Use	0.5	0.6	0.7	0.9
Inter-Provincial	0.3	3.0	2.9	1.2
Butane				
Production	0.7	3.0	3.0	1.7
Exports	0.7	3.0	3.0	1.7

* Figures do not add due to rounding

Source: Nova Scotia Department of Mines and Energy

Forest Biomass

Forestry operators could produce 25.5 trillion Btu of biomass (cull, waste, tops, chips, bark, sawdust, etc.) if all residues associated with the AAC were extracted. This is exclusive of the "one-shot" availability of dead stands, hardwood stands, etc. Wood demand is not forecast to exceed production, as shown in Table 2-22, and it is likely that the excess will be plowed under, burned to clear land or simply left as is.

Table 2-22

FOREST BIOMASS: SUPPLY/DEMAND
(trillion Btu)

	1985	1990	1995	2000	2005
Available from AAC operations	25.5	25.5	25.5	25.5	25.5
Demand	11.9	13.3	14.7	15.5	16.1
Remaining or Waste	13.6	12.2	10.8	10.0	9.4

Source: Nova Scotia Department of Mines and Energy

Hydro Power

All hydro will be consumed in the province except for minor efficiency exchanges with New Brunswick.

Municipal Solid Wastes, Wind, Solar

All energy produced will be consumed within the province, and supply is equal to demand.

Total Supply/Demand Balance

Nova Scotia's total supply/demand balance is shown in Table 2-23. The balance between provincial energy production and provincial energy consumption steadily improves, peaking in 1995 when the province has a net energy deficit of only 3.0 trillion Btu. After 1995, the deficit again begins to increase for two reasons: with no new coal mines forecast for the status quo case, the province must import coal; and with only Venture in the status quo case, gas production decreases by 2005.

Table 2-23

STATUS QUO CASE: PRIMARY ENERGY SUPPLY/DEMAND BALANCE*
(trillion Btu)

	1985	1990	1995	2000	2005
Production	103.3	172.8	292.5	290.5	283.3
Imports	128.0	143.2	130.5	153.1	195.4
Inter-Provincial Imports	23.6	9.2	7.5	7.2	7.8
Exports	16.3	56.6	119.1	112.5	63.2
Inter-Provincial Exports	1.2	3.1	15.9	6.1	4.5
TOTAL SUPPLY	237.4	267.5	295.5	332.2	368.8
REQUIREMENTS	237.4	267.5	295.5	332.2	368.8
Net surplus** or (shortfall)	(134.1)	(94.7)	(3.0)	(41.7)	(135.5)

* excluding inventory changes
** production minus requirements

Source: Nova Scotia Department of Mines and Energy

2.4 CONCLUSION

The status quo results lead to a number of fairly straightforward but striking conclusions. Despite considerable progress towards Nova Scotia's energy goals since the 1979 Energy Plan, there is still much that remains to be done.

As Part One described, the province's two paramount goals in energy policy are to ensure **stability** in energy markets and to use energy development to encourage **economic development**. The results of the status quo case indicate that a completely passive stance on the part of government leads to a number of shortfalls in respect of these goals.

Despite dramatic reductions in the share of the energy mix accounted for by oil forecast under the status quo case, the province would remain highly dependent on this imported and uncertain energy source. Despite the relative stability in world oil markets in the 1980s and the recent falls in the price of oil, there are sound reasons for believing that prices could again begin to escalate in the 1990s. It is also possible that supplies could again be curtailed by political developments, particularly in the Middle East. Nova Scotia will never be entirely independent of oil, but it is only prudent to ensure that all reasonable measures are taken to reduce the province's dependence.

The status quo case also shows a supply/demand imbalance in coal. Due to continued emphasis on coal-fired generation of electricity, the province faces a potential shortfall in coal supplies by the late 1990s in the absence of new mine development. The necessity of either importing coal or shifting to another energy source would result. Such a shortfall also precludes the economic benefits associated with supplying export markets with coal.

As well, projected domestic gas supply falls short of its potential use in the Nova Scotia energy mix.

In contrast, other resources such as wood and peat are under-utilized in the status quo case.

Finally, the potential of improved energy management is not fully exploited.

These outcomes are not consistent with the province's energy goals and it is clear that specific initiatives are required to ensure achievement of the most cost-effective degree of energy efficiency and the optimum use of indigenous energy resources.

Part 3.

The Target Case

3. THE TARGET CASE

3.0 INTRODUCTION

The provincial government can employ a variety of energy policy options ranging from complete energy market regulation to relying solely on the laws of supply and demand. The status quo case presented the probable results of a strategy relying primarily on market forces.

The status quo results in a number of less than optimum trends. For example:

- Dependence on oil will still continue to substantially exceed the national average, suggesting that further opportunities remain to substitute indigenous resources.
- Although substantial untapped coal resources exist, presently committed mining capacity will be insufficient to meet forecast domestic coal requirements and export opportunities.
- Benefits of offshore exploration and development may be foregone if projects subsequent to the Venture Gas Project (VGP) are not actively pursued.
- Some indigenous resources, most notably forest biomass and peat, will fall short of potential consumption levels.
- Considerable potential for energy efficiency improvements will remain untapped.

These forecast trends would clearly result in failure to achieve the maximum benefits available from energy supply and demand opportunities in Nova Scotia.

Through the use of effective planning and energy policy initiatives, the province has the ability to redirect the energy demand picture towards a target scenario which is more consistent with the long-term goals of market stability and economic development. Certain measures are available to government which can generate responses to anticipated future conditions that would be more desirable than an energy market left entirely to the short-term actions of consumers and producers, i.e. the status quo.

Part Three of this document presents such a target scenario, one which is both achievable and realistic. Resource and technological tools available to Nova Scotia are reviewed. Policy "initiatives" are suggested, which if implemented could result in achievement of the target scenario. Finally, the implications of such a scenario are discussed.

3.1 THE TARGET CASE

The objective of the provincial energy policy is an energy supply/demand balance which achieves complementarity in the goals of market stability and economic development. In general, these goals can be met through the substitution of indigenous resources for fuels now derived from sources outside of Nova Scotia, the increased production of these indigenous fuels and the implementation of cost-effective energy management measures to reduce the overall level of energy required.

The full potential of Nova Scotia resources and energy management opportunities will not be realized under the status quo case because of a variety of market barriers. While the barriers differ according to the resources, they may be categorized as: financial, informational, technological, and resource availability. Government can influence the supply and demand balance by eliminating or reducing the barriers to increased production of indigenous resources or more efficient use of all energy sources. Of course, the initiatives can only be chosen after careful evaluation to determine which fuels should be produced, how they should be acquired and consumed, and the range of options available to remove or reduce the barriers.

The design and implementation of such initiatives will result in a supply/demand balance different from that identified as the status quo case. This scenario represents the target energy supply/demand balance.

The initiatives presented in the target scenario result in a significant increase in the production and utilization of indigenous resources. Specifically, an additional offshore natural gas development, incremental to the Venture Gas Project, is forecast to begin production in the mid 1990's. As a result, the domestic natural gas distribution area is significantly enlarged. A new coal mine is brought into production so as to ensure that sufficient coal is available to both domestic and international markets. Other indigenous resources such as biomass, peat, municipal solid waste and coal gas are produced and consumed in larger quantities. Incremental conservation efforts result in significant improvements to the efficiency with which Nova Scotia consumes energy.

The economic activity associated with expanding the production and consumption of indigenous resources has a ripple effect on the anticipated performance of the Nova Scotia economy. As the economy expands in response to the energy related developments, so does the province's appetite for energy. As a result, the target scenario will result in a net increase in energy demand over and above the status quo case.

Appendix C summarizes the target assumptions related to economic activity, energy supply and demand. The remainder of this section details the target scenario.

Target Case Sectoral Energy Demand Forecasts

Residential Sector

The residential end-use target case forecast is presented in Table 3-1 and Figure 3-1. Total energy demand in the residential sector is expected to increase, but at a slower rate than in the status quo case. Demand is expected to reach 44.5 trillion Btu in 2005, representing a 0.8 percent annual increase compared to 49.6 trillion Btu, or 1.3 percent in the status quo case. The lower rate of increase is attributable to incremental conservation in older dwellings, improved efficiency of new dwelling units and increased use of more efficient fuels, particularly electricity and natural gas.

Table 3-1

TARGET CASE: RESIDENTIAL END-USE
ENERGY DEMAND FORECAST
(trillion Btu)

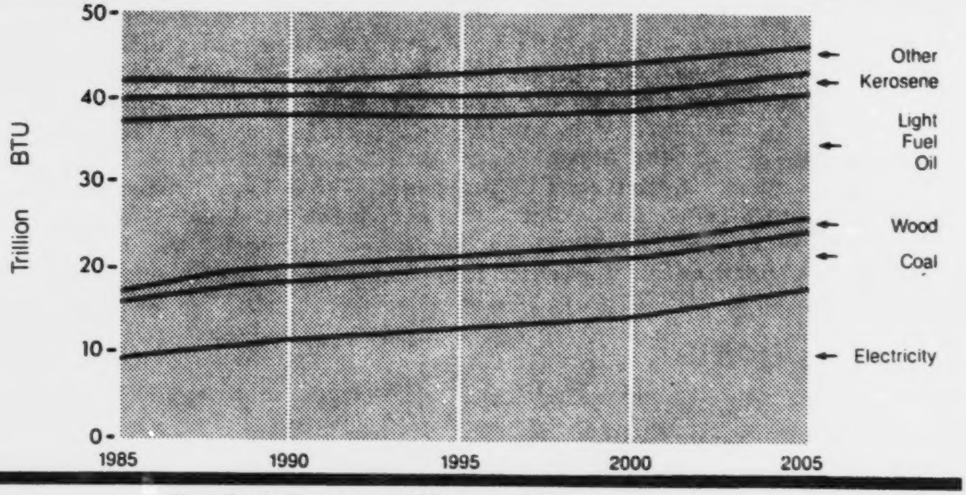
	1984	1990	1995	2000	2005
Electricity	8.4	10.7	11.9	13.4	16.7
Biomass	5.8	6.8	6.9	7.0	6.9
Natural Gas	0.0	0.0	0.7	1.3	2.0
NGL	0.0	0.0	0.4	0.7	0.6
Coal	1.4	1.4	1.5	1.6	1.7
RPP	22.2	21.0	19.3	18.0	16.5
Other	0.0	0.0	0.0	0.0	0.1
Total	37.8	40.0	40.7	42.0	44.5

Source: Nova Scotia Department of Mines and Energy

Electricity is expected to show the greatest increase in consumption. Demand for electricity could grow to 16.7 trillion Btu in 2005, compared to 21.5 trillion Btu in the status quo case. The slower rate of increase is attributable to increased penetration of natural gas after 1998 into the space and water heating markets, particularly in new construction, and also because of increases in conservation efforts.

The lower use of wood in the target case also reflects conservation efforts and the expansion of the natural gas service area after 1998. Total consumption should increase from 5.8 trillion Btu in 1984 to 6.9 trillion Btu in 2005, down from 7.1 trillion Btu in the status quo case.

FIGURE 3-1 TARGET CASE: RESIDENTIAL END-USE ENERGY DEMAND, 1985-2005



Source: Nova Scotia Department of Mines and Energy

Natural gas use increases in the target case as a new lateral gas pipeline is constructed to the Halifax/Dartmouth region. Production from a second offshore gas field permits expansion of the domestic gas service area. Gas consumption will increase to 2.0 trillion Btu in the target case compared to 0.8 trillion Btu in the status quo case.

Coal use is expected to increase from 1.4 trillion Btu in 1984 to 1.7 trillion Btu in 2005, compared to 1.4 trillion Btu in the status quo case. Increased consumption in the target case is due to such technologies as coal liquid mixtures overcoming handling and storage problems associated with coal. Refined petroleum products show an even greater decline in use than indicated in the status quo case. Increasing use of coal and natural gas, as well as conservation efforts, reduce demand from 22.2 trillion Btu in 1984 to 16.5 trillion Btu by 2005 in the target case (18.0 trillion Btu in the status quo).

Wind and solar energy should account for less than 0.1 trillion Btu of demand.

Commercial/Institutional/Public Administration Sector

Total commercial demand should increase from 27.7 trillion Btu in 1984 to 44.9 trillion Btu in 2005, an increase of 3.2 trillion Btu above the status quo case 2005 forecast. The incremental demand is attributed to economic growth within the sector, particularly in the service industries which support offshore gas development. The low 2.4 percent yearly increase is the result of successful conservation efforts.

The demand for electricity shows the largest increase, from 6.6 trillion Btu in 1984 to 14.4 trillion Btu in 2005, compared to 13.0 trillion Btu in the status quo case. The popularity of electricity as a source of power for electric motors and for space and water heating (particularly outside gas service areas) contributes to load growth.

Table 3-2 and Figure 3-2 present the end-use demand forecast for the target case.

Table 3-2

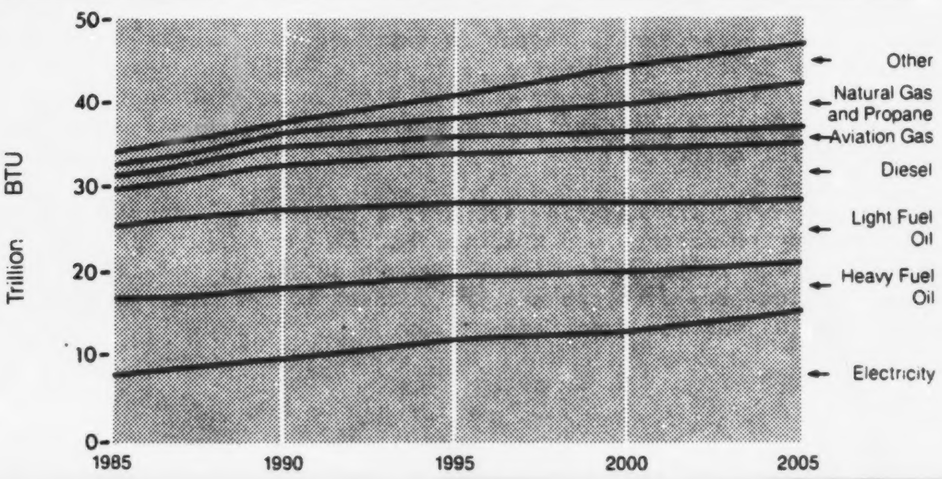
TARGET CASE: COMMERCIAL END-USE ENERGY DEMAND FORECAST
(trillion Btu)

	1984	1990	1995	2000	2005
Electricity	6.6	8.9	11.2	12.5	14.4
Biomass	0.0	0.3	0.6	0.9	1.4
Natural Gas	0.0	0.0	0.3	1.1	2.2
NGL	0.8	0.8	1.0	1.3	1.8
Coal	0.1	0.2	0.2	0.4	0.6
RPP	19.8	24.8	24.5	23.7	22.7
Other*	0.3	0.3	1.0	1.8	1.8
Total	27.6	35.7	38.8	41.8	44.9

* msw, peat, steam

Source: Nova Scotia Department of Mines and Energy

FIGURE 3-2 TARGET CASE: COMMERCIAL AND INSTITUTIONAL END-USE ENERGY DEMAND, 1985-2005



Source: Nova Scotia Department of Mines and Energy

The demand for natural gas and gas liquids also is forecast to increase above the status quo case forecast, since increased supply from the offshore permits eventual expansion of the gas service area, as well as attractive pricing for gas liquids.

Consumption of biomass is expected to commence and increase to 1.4 trillion Btu by 2005. This demand is expected as a result of acceptance of wood chips as a technically and financially feasible fuel in Nova Scotia.

Coal use is expected to increase to 0.6 trillion Btu in 2005, compared to 0.1 trillion Btu in the status quo case. Acceptance of new technologies such as coal/liquid mixtures and fluidized bed combustion should contribute to the increase in demand.

Municipal solid waste (msw) is expected to provide up to 1.5 trillion Btu of energy by 2005, particularly to the large institutional component of the sector. The consumption of msw will be popular with municipalities having waste disposal problems.

Steam, peat, wind and solar energy are expected to provide less than 0.3 trillion Btu in total, the majority of this being steam sold from Nova Scotia Power Corporation thermal stations.

Refined petroleum products continue to feel the impact of conservation and indigenous fuel use. Demand grows from 19.9 trillion Btu in 1984 to only 22.7 trillion Btu in 2005 in the target case, compared to 27.3 trillion Btu in the status quo. The reduction indicates that fuels other than refined petroleum products (msw, natural gas, biomass, electricity) will be popular in the new construction and retrofit markets, while conservation efforts will be directed primarily at older (i.e. generally oil burning) facilities.

Industrial Sector

Table 3-3 and Figure 3-3 present the industrial end-use energy demand forecast for the target scenario.

Total demand in the industrial sector is expected to increase from 42.8 trillion Btu in 1984 to 68.0 trillion Btu in 2005, compared to 60.4 trillion Btu in the status quo case. The industrial activity associated with offshore gas development leads the incremental demand as in the commercial sector.

The largest incremental increase in demand is found in the natural gas figures. Consumption reaches 6.3 trillion Btu in the target case by 2005 compared to 2.4 trillion Btu in the status quo case. Increased availability of gas from developments incremental to Venture permits expansion of the gas service area.

Table 3-3

TARGET CASE: INDUSTRIAL END-USE ENERGY DEMAND
(trillion Btu)

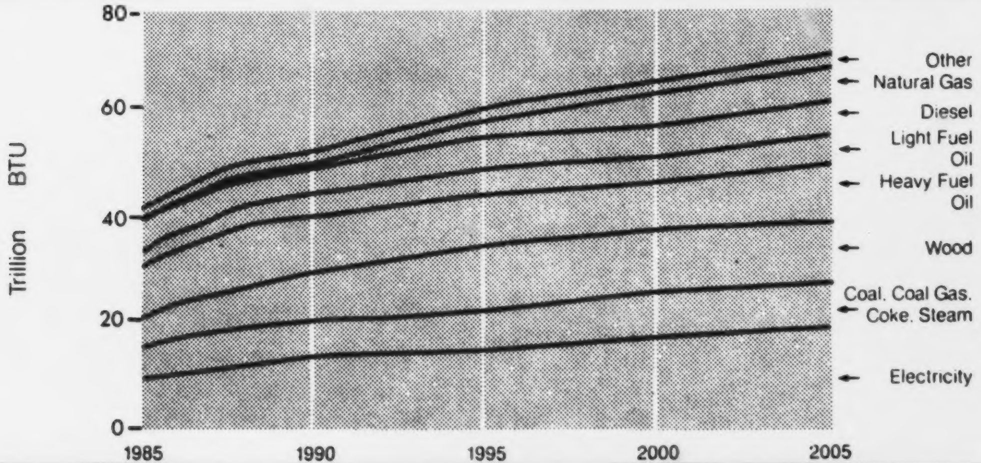
	1984	1990	1995	2000	2005
Electricity	8.5	12.3	13.8	16.3	18.2
Biomass	5.1	8.3	11.4	11.2	11.1
Natural Gas	0.0	0.7	3.1	6.2	6.3
NGL	0.0	0.3	0.3	0.4	0.6
Coal	1.2	1.6	2.0	2.6	3.2
RPP	16.8	20.5	20.8	20.1	22.9
Other*	11.2	5.0	5.6	5.6	5.7
Total	42.8	48.8	57.0	62.4	68.0

* Coke, coke oven gas, steam, peat, msw, solar, wind

Source: Nova Scotia Department of Mines and Energy

Electricity and biomass also show incremental increases in demand, climbing to 18.2 trillion Btu and 11.1 trillion Btu respectively in 2005, compared to 17.9 trillion Btu and 9.0 trillion Btu in the status quo case. These increases are accounted for by the popularity of these fuels in the new construction component of the sector, particularly in areas without access to natural gas.

FIGURE 3-3 TARGET CASE: INDUSTRIAL END-USE ENERGY DEMAND, 1985 to 2005



Source: Nova Scotia Department of Mines and Energy

Natural gas liquids and coal will be consumed at a more rapid rate in the target case. Coal should reach 3.2 trillion Btu by 2005 in the target case (3.1 trillion Btu in the status quo case). Natural gas liquids could account for 0.6 trillion Btu compared to 0.1 in the status quo case.

The level of total refined petroleum products demand should be similar in both the target and status quo cases, reaching 22.9 trillion Btu in 2005, implying a preference for fuels other than oil (peat, msw, natural gas, forest biomass, electricity) in the incremental facilities associated with the target case.

Peat (0.6 trillion Btu in 2005) and msw (0.1 trillion Btu in 2005) begin to contribute to industrial end-use demand in the target case. Both are expected to be used in large facilities located in close proximity to the fuel source.

Coke and oven gas are expected to remain at levels equal to the status quo case, since use will be limited to the Sydney Steel Mill.

Solar and wind are expected to produce less than 0.1 trillion Btu of end-use energy (as in the status quo case).

Transportation Sector

Table 3-4 and Figure 3-4 present the transportation forecast. Total demand is expected to increase to 80.0 trillion Btu by 2005 in the target case, compared to 75.4 trillion Btu in the status quo case. Demand is not influenced by incremental capital stock fuel efficiencies above those assumed in the status quo case. Total demand increases as a result of enhanced economic growth leading to increased numbers of vehicles. Demand increases are slightly offset by traffic management initiatives.

Table 3-4

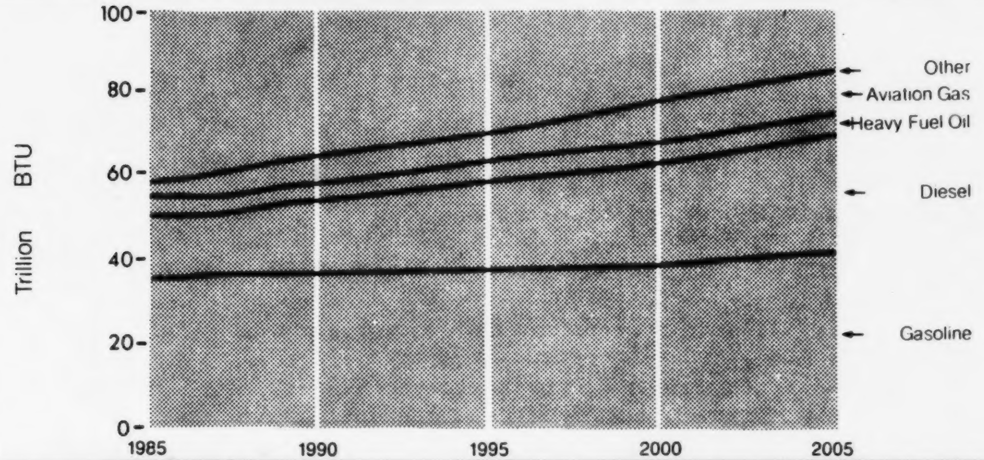
TARGET CASE: TRANSPORTATION END-USE ENERGY DEMAND
(trillion Btu)

	1984	1990	1995	2000	2005
Diesel	14.4	16.7	20.2	23.0	26.2
Motor Gasoline	36.0	34.1	35.2	36.0	39.0
Aviation Gasoline	3.3	5.8	6.4	7.6	8.7
Heavy Fuel Oil	3.6	3.9	4.6	4.9	5.2
Propane	0.2	0.2	0.3	0.5	0.9
Natural Gas	0.0	0.0	0.0	0.0	0.1
Total	57.5	60.7	66.7	72.0	80.0

Source: Nova Scotia Department of Mines and Energy

In 2005, demand for all transportation fuels except automotive gasoline is expected to increase in the target case when compared to the status quo case. The slightly lower gasoline demand results from the substitution of propane for gasoline in the road vehicle market, particularly in fleet vehicles. Propane is expected to increase from 0.2 trillion Btu in 1984 to 0.9 trillion Btu in the target case (0.2 trillion Btu in the status quo case).

FIGURE 3-4 TARGET CASE: TRANSPORTATION END-USE ENERGY DEMAND, 1985 to 2005



Source: Nova Scotia Department of Mines and Energy

Total End-Use Energy Demand

Table 3-5 and Figure 3-5 present total end-use demand for the target case.

Total demand will grow from 165.8 trillion Btu in 1984 to 237.5 trillion Btu in 2005, compared to 227.1 trillion Btu in the status quo case.

Total demand for electricity reaches 49.3 trillion Btu in 2005, compared to 52.4 trillion Btu in the status quo case. The slight reduction in growth rate is attributed to increased use of other indigenous fuels, particularly natural gas, in the new construction market.

Table 3-5

TARGET CASE: TOTAL END-USE ENERGY DEMAND*
(trillion Btu)

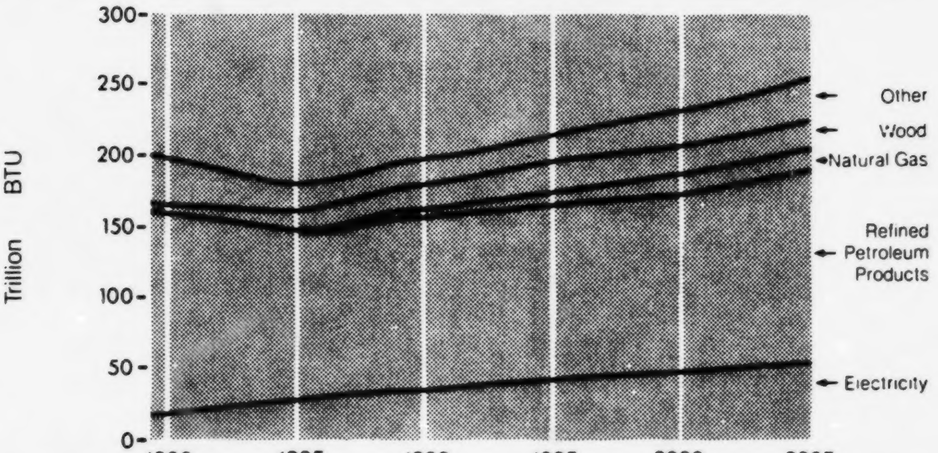
	1984	1990	1995	2000	2005
Electricity	23.5	31.9	36.9	42.2	49.3
Biomass	10.9	15.4	18.9	19.1	19.4
Natural Gas	0.0	0.7	4.1	8.6	10.6
NGL	0.8	1.2	1.8	2.7	3.6
Coal	2.7	3.4	3.7	4.6	5.5
RPP	116.4	126.9	131.2	133.5	141.5
Other**	11.5	5.3	6.6	7.4	7.6
Total	165.8	184.8	203.2	218.1	237.5

* excludes own use and losses
** includes coke, coke oven gas, solar, wind, steam, msw, peat.

Source: Nova Scotia Department of Mines and Energy

Consumption of indigenous biomass, natural gas, coal, msw, peat, solar wind and natural gas liquids increases by a total of 16.7 trillion Btu by 2005 in the target case as compared to the status quo. Use of refined petroleum products by 2005 declines slightly from 145.3 trillion Btu in the status quo case to 141.5 trillion Btu in the target case. Conservation directed at buildings existing in 1984 (primarily older i.e. oil burning) and market share competition from indigenous fuels accounts for this decline.

FIGURE 3-5 TARGET CASE: TOTAL END-USE ENERGY DEMAND, 1979 to 2005



Source: Nova Scotia Department of Mines and Energy

Primary Energy Demand

Table 3-6 and Figure 3-6 present the demand for primary energy which results from the target case end-use forecast presented above.

Table 3-6

TARGET CASE: PRIMARY ENERGY DEMAND
(trillion Btu)

	1984	1990	1995	2000	2005
Coal	61.7	89.2	113.7	131.2	157.2
Biomass	10.9	15.4	18.9	19.1	19.4
Natural Gas	0.7	0.7	4.1	8.6	10.5
Crude Oil And Pentanes Plus	147.4	144.4	143.6	145.2	154.0
Hydro Electricity*	10.5	19.7	17.3	17.4	17.7
Natural Gas Liquids	0.0	1.4	1.9	2.5	3.3
Peat	0.0	0.0	0.6	0.6	0.6
MSW	0.0	0.1	0.9	1.6	1.6
Other**	0.0	0.0	0.0	0.1	0.1
Total	231.2	270.9	301.0	326.3	364.4

* including net imports which amounted to only 0.2 trillion Btu in 1984

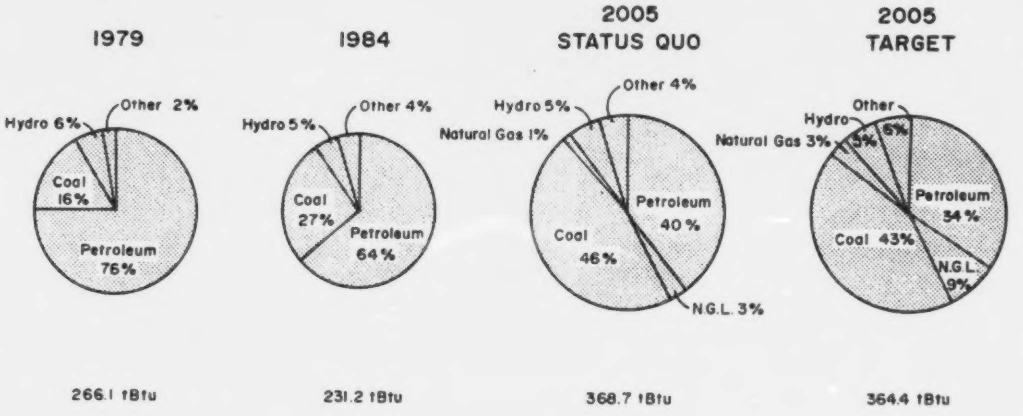
** solar, wind

Source: Nova Scotia Department of Mines and Energy

Total demand will grow at a rate of 2.2 percent per annum in both the target and status quo cases. Despite the increased economic activity underlying the target forecast, primary energy consumption is not expected to grow at a faster pace in the target case due to the increased use of more efficient fuels such as natural gas. Total demand in 2005 reaches 364.4 trillion Btu in the target case compared to 368.8 trillion Btu in the status quo case.

The reduced energy demand is accounted for by a slight reduction in domestic use of coal (170.7 trillion Btu in 2005 in the status quo versus 157.2 trillion Btu in the target case) and in the requirements for crude oil (124.1 trillion Btu in the target case compared to 148.7 trillion Btu in the status quo case). The incremental use of new and existing fuel sources such as msw, peat, natural gas and biomass results in a slower rate of growth in demand for electricity in the target case. Because electric generation is dominated by coal-fired thermal generation for base load expansion in the Nova Scotia Power Corporation expansion plan, the slower growth in electricity demand translates into a lower overall demand for coal for electric generation. However, overall coal production increases in the target case as a new mine is opened to supply both domestic and export markets.

FIGURE 3-6 TARGET CASE: PRIMARY ENERGY DEMAND

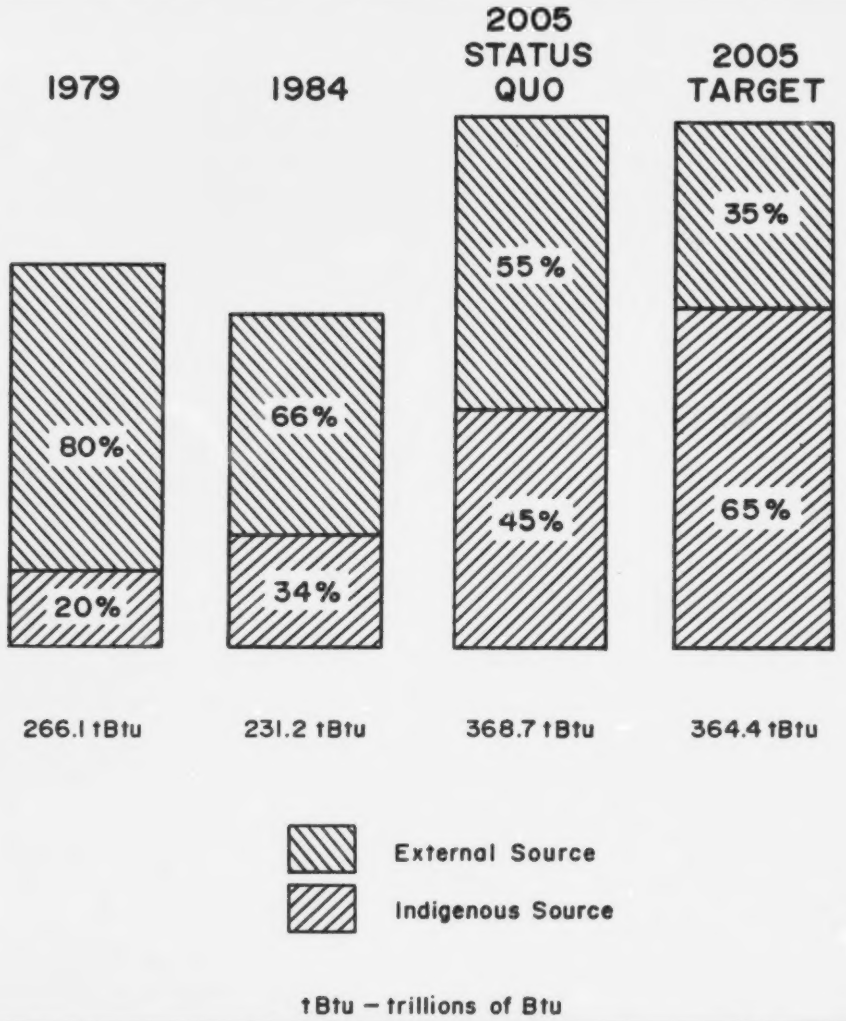


Note : Other includes biomass, solar, wind, peat, municipal solid waste
Natural gas liquids (N.G.L.) includes pentanes plus.
tBtu – trillions of Btu
Source: Nova Scotia Department of Mines and Energy

Use of other fuels stays constant or increases above their 2005 status quo case levels. Biomass increases from 16.1 trillion Btu to 19.4 trillion Btu. Natural gas demand rises from 3.9 trillion Btu to 10.5 trillion Btu. Pentanes plus as a refinery feedstock rises to 29.9 trillion Btu from 10.3 trillion Btu. Natural gas liquids increase from 0.9 trillion Btu to 3.3 trillion Btu. Peat and msw make their first significant appearance. Nova Scotia Power Corporation hydro electricity generation remains constant. Purchases from New Brunswick result in a net increase in primary electricity consumption.

The target case results in a lowering of dependence on energy sources outside the province (primarily crude) from 55 percent of primary energy demand in 2005 in the status quo case to 35 percent in the target case (as shown in Figure 3-7). Increased production and consumption of indigenous primary fuel sources occurs in natural gas, natural gas liquids, msw, peat, coal, crude oil, biomass, solar and wind energy.

FIGURE 3-7
NOVA SCOTIA PRIMARY ENERGY DEMAND
Indigenous Versus Foreign Sources



Source: Nova Scotia Department of Mines and Energy

The remainder of this section will describe those activities which can be undertaken by the province to yield the target case described above. It addresses the options available, the method of option selection and initiatives designed to achieve the desired results.

Policy Options Available

The province's policy options can be best described as mechanisms for overcoming the barriers to achieving goals set by the target case.

The options open to the province range from the distribution of general information on technical and financial feasibility using such media as pamphlets, through the demonstration of complex technologies and use of financing alternatives and capital grants, to the use of legislation and enforcement. The measures depend on the barrier to be overcome; they represent the minimum level of government intervention.

Implicit in the initiatives is knowledge of the energy resources available to the province, the new or emerging technologies for reducing energy demand and the factors which influence consumer decisions to either use a particular fuel or implement measures to improve energy efficiency.

The province's policies must encourage appropriate use of certain resources and technologies. In this way, the province can steer energy markets in a direction which is deemed to be consistent with long-term goals.

Existing and new resources were reviewed in Part Two. New technologies available will be discussed later in this section.

Selection Criteria

In order to narrow the number of policy choices, a number of selection criteria were employed.

Technical feasibility: Numerous technologies now exist or are at a stage of development such that they can be applied well within the time frame of this plan. Others which may prove feasible at some future point will be monitored but are not currently feasible.

Cost-effectiveness: Two considerations are appropriate: the economic feasibility of the fuel or technology to the producer or consumer and the cost to government of applying necessary incentives.

Level of intervention: Although there is a variety of policies available to change energy patterns, some will tend to be more coercive, expensive, or heavy-handed than others. Generally, change that can be encouraged through minimal intervention such as information programs is preferred to change achieved through regulations or grants which may have distorting side-effects.

Potential to induce economic development: A number of options have the potential to improve economic development, regional distribution of employment, income growth or associated economic growth opportunities.

Consistency with past policy: Past energy planning efforts have established general trends which should be built upon rather than abandoned. Therefore, options which build on existing strengths are preferable to ones which represent completely new departures.

Environmental considerations: Effects on the environment are weighed in the consideration of options.

Physical resource constraints: Any initiative must pay attention to the availability of the resource being promoted.

Application of these criteria has yielded a short list of technologies, fuels and related initiatives which, taken together, could produce the target case. The following sections outline these initiatives.

3.2 RECOMMENDED POLICY OPTIONS

Energy Efficiency

The first result of applying the selection criteria is recognition of the benefits of increasing the efficiency with which we consume energy. In addition to being the most straightforward approach to controlling costs of both energy production and consumption, conservation is generally technically feasible and provides substantial economic benefits in terms of employment. Using less imported energy lowers costs to Nova Scotians, while using less of the province's indigenous energy conserves it for future use. Moreover, the initiatives required to achieve improved energy management are often relatively low-cost and require only a minimum of intervention in the market.

Implementation of the 1979 Energy Plan conservation recommendations produced impressive gains in energy efficiency, but considerable potential for improvement remains. The information and demonstration projects in the past five years, together with a strong measure of fiscal incentives, have established the beneficial results of energy management for the private consumer. Those benefits have, on the whole, already been realized by those energy consumers prepared to actively seek out information and utilize government programs. These possibilities must now be communicated to a wider sector of the public.

In order to realize remaining potential, several barriers must be addressed by the initiatives. The public must be made more aware of the existing potential and the benefits which could result from increased energy efficiency. Technical and financial risks which are currently precluding the implementation of cost-effective energy management activities must be addressed. In general, individuals and organizations with the potential to economically conserve energy must be motivated to do so even more than at present.

A list of representative energy management initiatives designed to address barriers to conservation in Nova Scotia is provided in Box 3-1. These initiatives are categorized by sector and listed in order of priority within each sector.

In general, these initiatives concentrate on the provision of conservation information to energy consumers through the use of media, demonstration projects, workshops, etc.

In addition, energy audits, innovative financing, grants or cost-sharing can be used to reduce the technical or financial risk to the consumer of investing in combustion or structural efficiency improvements.

Box 3-1

REPRESENTATIVE ENERGY MANAGEMENT INITIATIVES

General

Review past and existing programs to determine their appropriateness and to ensure the cost-effectiveness of new programs.

Ensure that provincial government programs related to energy are coordinated between departments and with those offered by the federal government.

Promote energy management techniques through publications, audio-visual presentations, seminars and workshops in cooperation with the federal government.

Include energy efficiency standards within any future provincial building code.

Provide industry, business and the general public with access to energy related information through the ongoing support of an energy information centre.

Residential

Organize and promote province-wide workshops on such topics as condensation prevention, retrofit problems, airsealing, etc.

Produce and promote an Energy Efficiency Guide for Renovators.

Utilize existing programs (such as the Summer Works Program) to provide weatherization assistance to needy groups.

Review trade school and training institution courses, and improve the energy management component; investigate the feasibility of refresher courses on energy management.

Organize a pilot project providing a testing program for complete heating systems.

Cost-share the purchase of combustion efficiency testing equipment to ensure its availability throughout the province

Promote combustion efficiency testing for fossil fuel heating systems, to be provided by existing burner companies.

Provide energy audit programs for homeowners.

Introduce an energy rating system for new homes in cooperation with the building industry.

Industrial/Commercial/Institutional

Develop and implement a strategy to reduce provincial government energy expenditures through an interdepartmental committee which establishes targets, identifies initiatives, coordinates activities and monitors results.

Provide energy analyses to provincial and municipal government agencies and small business to identify opportunities to reduce energy costs.

Identify barriers to the implementation of energy management recommendations; develop and initiate appropriate measures to overcome such barriers.

Examine methods of reducing the perceived financial and technical risk of retrofit activities. Encourage innovative financing mechanisms and a more effective use of energy consulting services.

Identify energy management opportunities in specific sectors such as agriculture, fish processing and sawmilling, and through various information transfer activities, make management aware of the opportunities.

In cooperation with the federal government, demonstrate new or evolving energy management technologies and assist in the development of energy efficient products.

Transportation

Develop and implement an information program for the trucking industry, both line-haul and city delivery, identifying the savings available from improved energy management.

Examine appropriate mechanisms and develop a strategy to implement traffic management improvements in urban/suburban areas throughout the province in cooperation with the Department of Municipal Affairs.

Promote ride-sharing programs in urban areas and near large rural plants by presentations to employers and employees, advisory services and publicity campaigns.

Anticipated results range from attitude changes (e.g. setting thermostats back or use of public transit) to the implementation of sophisticated energy management technologies such as waste-heat recovery equipment in the industrial/commercial sector.

On a sectoral basis, such energy efficiency initiatives could result in substantial savings. In the residential sector, the average household end-use energy consumption of dwellings which existed in 1984 could be lowered 21.2 percent by 1989. When examined over the entire forecast period and neglecting the impacts of increased economic growth associated with the target case, this would result in a reduction in residential end-use energy demand in 2005 to 43.2 trillion Btu, or 12.8 percent below the status quo case forecast of 49.6 trillion Btu. However, when incremental consumption resulting from the enhanced economic activity and population growth in the target case are included in the forecast, these offset the conservation reduction, resulting in a target case forecast of 44.5 trillion Btu, or 10.3 percent below the status quo case.

In the commercial sector, energy management initiatives should lower the average energy use per existing establishment (as of 1984) by 15 percent by 2005. Without the enhanced economic activity associated with the target case, this translates into a 4.8 trillion Btu, or 11.5 percent reduction below the status quo 2005 value of 41.7 trillion Btu. However, economic activity offsets the reduction resulting in the target case commercial forecast of 44.9 trillion Btu, compared to 41.7 trillion Btu for the status quo case.

Energy demand per existing establishment in the industrial sector could be lowered by 13.6 percent by 2005. Again, without the target case's enchanced economic activity, this would result in a lowering of the status quo forecast from 60.4 trillion Btu to 54.3 trillion Btu by 2005. Economic growth offsets such reductions resulting in the target case consumption exceeding the status quo in 2005 (68.0 trillion Btu versus 60.4 trillion Btu respectively).

The transportation sector is more difficult to control from the provincial perspective as efficiency of capital stock is largely determined outside the province. As such, it is not expected that conservation initiatives will provide as substantial a reduction in this sector as shown in others.

It is clear from the above that energy management activities play a major role in the target case. Without further conservation initiatives, demand in the target case would have been significantly greater than the estimates given in the forecast.

New Production and Consumption Technologies

In addition to existing production and consumption technologies, a wide spectrum of "new technologies" are available. Figure 3-8 outlines the new technologies available to the province which have been considered in the preparation of this document, and categorizes them as either utilization or production-oriented technologies.

"New technologies" are those processes which facilitate either production or consumption of energy resources, are not presently used in the province and are not forecast to be used in the status quo case. They are included in the target case because they will be beneficial to the province's energy goals, but will probably not proceed without provincial government action. Technologies included in the status quo case are either employed in the province already or will most likely be adopted without government initiatives.

Application of the selection criteria discussed earlier indicates that not all new technologies are suitable for use within the province. For example, cost-effectiveness and technical feasibility considerations indicate that coal gasification projects are not feasible within the planning horizon. Similarly, the use of hydrogen and electric vehicles are not considered appropriate because of technical limitations. Technologies such as these must be monitored on an ongoing basis and subject to periodic feasibility analysis to determine their potential for future inclusion within the Energy Plan.

The new technologies which are incorporated into the target case are listed briefly below. These technologies are not expected to be utilized in the province unless government initiatives are employed to reduce or eliminate the barriers presently inhibiting their acceptance. Therefore, they were not included in the status quo forecast. Those included in Figure 3-8 but not listed below have been excluded from this Plan based on application of the selection criteria.

Coal Technologies

Coal Liquefaction

Coal liquefaction is the process of chemically converting coal into liquid hydrocarbons (RPPs), either directly through the chemical addition of hydrogen or indirectly by first breaking the coal down and combining it with hydrogen.

In 1981, the Scotia Coal Synfuels Consortium was formed to examine the economic and technical feasibility of building a coal liquefaction plant to produce transportation fuels. Cape Breton was selected as a possible site for the plant because of its large resources of coal, a skilled labour force and an existing transportation and service infrastructure.

FIGURE 3-8 POTENTIAL ENERGY TECHNOLOGIES

FUEL	TECHNOLOGY	CONSUMPTION	PRODUCTION	CRITERIA
COAL				
	Coal/liquid mixtures	X		Technically feasible; consistent with past policy; environmentally sound.
	Fluidized bed combustion	X		Technically feasible; consistent with past policy
NATURAL GAS				
	Motor vehicle fuel	X		Cost-effective and technically feasible
	Coal seam demethanization		X	Environmental improvements
	Gasification of biomass and coal		X	Questionable cost-effectiveness and technical feasibility
	Pyrolysis of biomass		X	Questionable cost-effectiveness and technical feasibility
	Biogas (anaerobic digestion of biomass)		X	Questionable cost-effectiveness and technical feasibility
	Liquified natural gas		X	Questionable cost-effectiveness compared to a pipeline
PROPANE				
	Motor vehicle fuel	X		Technically feasible; cost-effective; environmentally sound
	Propane prebuild		X	Main issue is cost-effectiveness
STEAM				
	Geothermal		X	Technically feasible, environmentally sound
PEAT				
	Surface mining		X	Technically feasible, low level of intervention
SOLAR				
	Photovoltaics for large scale electricity		X	Questionable cost-effectiveness and technical feasibility
GEOTHERMAL				
	Heat pumps	X	X	Technically feasible, main issue is cost
ALCOHOL				
	Standard combustion	X		Questionnable cost-effectiveness
	Automotive fuel	X		Questionnable cost-effectiveness
	Hydrolysis of biomass		X	Questionable cost-effectiveness and technical feasibility
	Fermentation of biomass		X	Questionable cost-effectiveness and technical feasibility
	Petrochemically produced from crude oil and natural gas		X	Questionable cost-effectiveness and technical feasibility
HYDROGEN				
	Vehicle fuel	X		Questionable cost-effectiveness and technical feasibility
	Space heating	X		Questionable cost-effectiveness and technical feasibility
	Electrolysis		X	Questionable cost-effectiveness and technical feasibility
CRUDE OIL				
	Pyrolysis of biomass		X	Questionable cost-effectiveness and technical feasibility
RPPs (Refined Petroleum Products)				
	Coal liquefaction		X	Cost effective and consistent with past policy
ELECTRICITY				
	Electric automobiles	X		Level of intervention
	Large scale wave power		X	Questionable cost-effectiveness and technical feasibility
	Large scale thermal using biomass, peat or MSW		X	Questionable cost-effectiveness and technical feasibility
	Fuel cells		X	Questionable cost-effectiveness and technical feasibility
	Large scale wind		X	Questionable cost-effectiveness and technical feasibility
	Nuclear fission		X	Environmentally controversial
	Fusion		X	Questionable cost-effectiveness and technical feasibility

Source: Nova Scotia Department of Mines and Energy

The first phase of the project assessed available technologies around the world and the results indicated that coal from the Lingan mine on the north shore of Cape Breton was among the most suitable in the world for conversion into liquid transportation fuels. Further analysis indicated that "single-stage" liquefaction, while technically possible, did not produce high enough liquid yields to make the process economic at world oil price levels. Improvements in direct liquefaction technology indicate that a "two-stage" process (two reactors in sequence) could attain higher yields than single-stage direct liquefaction. Laboratory work and pilot project testing is still required to select the optimum process before a commercial application will be viable.

Fluidized Bed Combustion

Fluidized bed combustion is a process in which inert granular materials are kept in suspension by a current of air or some other gas. Finely-ground fuel, in this case coal, is fed into the bed and heated by contact with the inert material and hot air. The coal burns efficiently because each particle is in constant motion and in contact with the moving gas stream on all sides.

Because the ratio of inert material to fuel in the bed is high, low-grade fuels can be utilized (e.g. rejects from a coal wash plant). Limestone added to the bed reacts with sulphur dioxide to form a solid calcium sulfate, thus reducing atmospheric sulphur dioxide emissions.

Fluidized bed combustion units could replace over a quarter of the oil-fired units presently used in the industrial and commercial/institutional sectors.

Coal-Liquid Mixtures

Coal-liquid mixtures (CLM) cover a number of fuels including coal-oil mixtures (COM), coal-water mixtures (CWM), coal-methanol (CM) and various combinations of all three. Carbogel, described in Box 2-3, is an example of a CLM.

In 1979, Scotia Liquicoal began work with coal-liquid mixture fuels at the Technical University of Nova Scotia (TUNS). By 1981, they had constructed a demonstration and pilot plant facility in Dartmouth to manufacture coal-liquid mixture fuels for combustion testing, as well as associated research and development programs. Additional research is being carried out at the Nova Scotia Research Foundation Corporation, the Atlantic Research Laboratory and TUNS.

Coal-liquid fuels have the potential of replacing oil in existing boilers, generating units or steam-raising units without a major overhaul to the fuel train, storage or handling systems. At present, the cost to the user of coal-liquid mixtures is closer to the cost of oil than the cost of coal, but continuing research could lead to cost reductions and consequent increases in demand. Demand for coal could be substantially increased by the success of coal-liquid fuels.

Natural Gas Technologies

Natural Gas From Coal Seams (Demethanation)

Demethanation is a technique employed to recover methane as a fuel from coal seams and is commonly referred to as virgin coal demethanation, or VCD. In addition to producing methane, demethanation improves mine safety.

Demethanation has been under study in the province since 1978, when NovaCorp and the Cape Breton Development Corporation (CBDC) began research and development on the extraction of methane from the Lingan and No. 26 Mines. CBDC has now completed the construction of an underground methane gas gathering system in the Lingan Mine.

In 1979, NovaCorp also initiated a demethanation project to extract naturally occuring methane gas from coal seams in the Stellarton, Pictou County area where two production wells are presently producing over 20,000 cubic feet per day.

CNG or Natural Gas Vehicles

One of the technologies available to generate a large demand for natural gas is the natural gas vehicle (NGV). Virtually any gasoline-powered car or truck can be equipped to run on compressed natural gas (CNG). A conversion system can be easily installed, allowing the vehicle to run on either natural gas or gasoline at the flip of a switch. Vehicles run between 150 and 300 miles per "fill-up" despite the large, heavy fuel tanks required.

Retail sales at filling stations require an expensive fuel distribution system and sufficient retail outlets to attract consumers. Experience in Alberta suggests that vehicle fleets, such as taxi companies or utility vehicle fleets which are centrally fuelled, are the best initial targets.

Electric Technologies

Large-Scale Heat Pumps

Heat pumps operate on the same principle as a refrigerator but in reverse. Electricity is used to "pump" heat from a heat source of a lower temperature, such as outside air or groundwater, to an area where a higher temperature, or heat, is required, such as the interior of a house. The heat energy pumped exceeds the electrical energy consumed by the equipment. Operating efficiencies of 150 to 225 percent can be expected from properly designed air or water source heat pumps, depending on the source temperature, and can reach as high as 350 percent for water source heat pumps.

One site of particular interest is located in the Springhill area. The potential of using the water in flooded coal mines has attracted considerable interest. Funding is being sought by the town to assess feasibility and siting.

Electric Duct or Plenum Heaters

At the present time, electrical heating in Nova Scotia is confined mainly to electric resistance baseboard units. These units contribute to the Nova Scotia Power Corporation system peak load, which is supplied mainly through costly oil-fired generation. The use of electrical warm air plenum heaters together with an oil-fired back-up system could considerably increase the use of electricity for space heating during utility off-peak hours.

If a house has a central forced-air heating system, electrical resistance elements can be installed within a warm air plenum to heat the air being distributed to the house. When used in combination with another fuel, these systems are referred to as hybrid systems.

The usual mode of operation is to have the duct heaters provide space heating until the outdoor temperature falls below a predetermined level, at which point the other fuel source takes over. Electricity often displaces 70 to 80 percent of the annual fuel consumption in these hybrid systems, but any cost savings will depend on the difference in cost between the electricity required and the fuel displaced.

Fuel Selections

The following sections provide a description of all fuels which have been selected to play a significant role until 2005. As in the cases of energy efficiency and new technologies, the fuel choices and accompanying recommended initiatives in this section are the result of applying selection criteria to the range of possibilities. The indigenous fuel sections are presented in order of anticipated decreasing contribution to end-use energy demand in 2005. Residual or imported fuels follow. Each fuel is discussed in both end-use and primary form.

Electricity

The status quo case suggested that by 2005 electricity would be the most popular form of end-use energy in Nova Scotia. This trend is also evident in the target case as a result of the advantages which electricity offers. The utilization of electricity is efficient and, as long as it is produced using indigenous fuels rather than imported oil, it is an end-use energy source entirely compatible with provincial energy policy goals.

Further promotion of electrical demand technologies can be pursued, particularly the use of plenum heaters. As discussed under energy efficiency above, increasing the efficiency with which we use electricity is also possible. A reduction in electricity consumption appears probable in the target case when compared to the status quo case, resulting primarily from increasing penetration of natural gas into the space, water and process heating markets.

Electrical initiatives designed to support such trends are described in Box 3-2.

Box 3-2

SUGGESTED ELECTRICAL INITIATIVES

Provide a public information program on the technology and economics of using heat pumps for space heating and waste heat recovery.

Examine the economic and technical feasibility of small-scale co-generation facilities fueled with chipped forest residue.

Undertake a demonstration project to determine the benefits of electric plenum heaters in terms of improved utility load and reduced oil consumption, and the effects on the consumer.

Evaluate the effectiveness of the Health Services Tax rebate for the unconventional portion of wind generating systems, and continue it if warranted.

Monitor technological changes and improvements in small-scale wind generation, and, if appropriate, encourage further demonstration projects in the 25 to 150 kW range in order to assist small-scale wind generating manufacturers.

Continue to monitor the feasibility of developing large scale tidal electric generating facilities to supply both domestic and export markets.

Complete a resource evaluation of the geothermal potential in the Springhill area, and if the results are positive, undertake an electric heat pump demonstration project to provide necessary technical and financial information to potential producers.

Assess the potential of geothermal energy in areas other than Springhill.

The target case supply/demand balance for electricity is shown below. Hydro production should remain constant, as in the status quo case. Thermal production increases to 89 percent of generation from 79.4 percent in 1985. The slight reduction in end-use demand when compared to the status quo results in the deferral of 300 megawatts of coal-fired capacity from the Nova Scotia Power Corporation generation expansion plan. This deferral affects only those generation plants planned for domestic markets, not those constructed to serve export markets. Net efficiency purchases* from New Brunswick are expected throughout the forecast period.

---

* NSPC and the New Brunswick Electric Power Commission routinely exchange power in order to maximize the operational efficiency of their systems.

Table 3-7

TARGET CASE END-USE ELECTRICITY:
SUPPLY/DEMAND BALANCE*
(trillion Btu)

	1985	1990	1995	2000	2005
End-use Demand	24.7	31.9	36.9	42.2	49.4
Own Use and Losses	3.0	3.9	4.3	4.9	5.8
	----	----	----	----	----
Total Requirements	27.7	35.8	41.2	47.1	55.2
Supply					
Hydro	3.5	3.5	3.5	3.5	3.5
Thermal	22.0	29.1	35.3	41.2	49.2
Net Interprovincial	2.2	3.2	2.4	2.4	2.5
	----	----	----	----	----
Total	27.7	35.8	41.2	47.1	55.2

* denominated in 3412 Btu/kWh

Source: Nova Scotia Department of Mines and Energy

Forest Biomass

Forest biomass was selected on the basis of several criteria. It presents a number of opportunities to enhance the use of indigenous fuels in Nova Scotia. Roundwood fuel, forest residue from logging operations and waste wood from manufacturing are surplus to demand for fuel wood. Economic spinoffs from indigenous biomass production and use offer substantial benefits in terms of employment and balance of payments, as money usually spent on imported oil is retained primarily within the province. Finally, efficient and economic technologies exist to both produce and consume wood, including the cogeneration of steam and electricity at appropriate industrial, commercial and institutional sites.

In order to attain incremental wood consumption, effort must be made to overcome the barriers presented to both supply and demand. Potential consumers, including government facilities, must be made more aware of the benefits of wood consumption and the associated economics. Individuals or companies in a position to produce wood for fuel must also be made more aware of available technologies (particularly wood chipping) and economic benefits of such production. The province must also ensure that any incremental use of wood does not take place at the expense of the environment either in terms of air quality or forest conditions. Suggested initiatives are outlined in Box 3-3.

Box 3-3

SUGGESTED FOREST BIOMASS INITIATIVES

Undertake an information program to ensure that potential consumers are aware of the technology available and the economics of chip consumption.

Encourage the substitution of wood chips for petroleum products as fuel in government owned buildings, and undertake demonstration projects to encourage small energy users to convert to wood chips.

Study and evaluate opportunities for using forest biomass to cogenerate steam and electricity at potential sites in the province. Encourage the adoption of this technology where technically and financially attractive, through demonstration, technology transfer and other means.

Encourage feasibility studies on conversions from fossil fuels to wood chips by providing information programs on such funding mechanisms as innovative third party financing.

Collect and evaluate cost and production information on chipped biomass under different operating conditions.

Study, assess and publicize the economic impact of wood chip production under such categories as job creation, taxation, manufacturing and service industry opportunities, benefits to the forest industry, etc.

Undertake a comprehensive study of the long-term effects of harvesting logging residues and unmerchantable timber, and of the effects of increased wood combustion.

The anticipated forest biomass supply/demand balance is shown below:

Table 3-8

FOREST BIOMASS: TARGET CASE SUPPLY/DEMAND BALANCE
(trillion Btu)

	1985	1990	1995	2000	2005
Demand	12.3	15.4	18.9	19.1	19.4
Supply					
From AAC Operations	25.5	25.5	25.5	25.5	25.5
Surplus	13.2	10.1	6.6	6.4	6.1

Source: Nova Scotia Department of Mines and Energy

Despite target case initiatives, a substantial surplus of wood will remain. In addition, this surplus calculation does not use the 322 trillion Btu (18.7 million bone dry tons) represented by the "one shot" stands of unmerchantable timber. The economics of acquiring some remote sources of wood waste and unmerchantable species will continue to discourage its use, thus resulting in an unused surplus.

Indigenous Natural Gas, Gas Liquids and Crude Oil Products

The use of indigenous natural gas, gas liquids and crude oil is an important goal of the government of Nova Scotia. The potential economic benefits to the province from the exploration, development and production of these energy sources are well documented. The opportunities to substitute indigenous gas or oil for imported petroleum products are numerous. The use of natural gas and liquids is environmentally preferred to the use of oil, due to the lower levels of atmospheric pollutants produced. The technology required to both produce and consume natural gas, liquids and oil are well proven and available.

The optimum use of indigenous natural gas and liquids will require a substantial effort directed towards public awareness and acceptance of the fuels, even though natural gas, for example, is used extensively in other parts of Canada. Because of consumer resistance to new fuels, programs may be required to provide technical advice and information to those wishing to convert from more traditional energy sources. Efforts may also have to be made to ensure sufficient trained personnel to enable conversion of Nova Scotia establishments to gas or liquid fuels.

On the exploration and production side, timely issuance of lands, attractive fiscal regimes and efficient regulatory review will all be necessary to encourage ongoing activity, particularly production beyond the Venture Gas Project. Encouragement of coal gas production could also result in a new source of indigenous fuel.

The recommended initiatives are presented in Box 3-4.

The probable supply/demand balance for natural gas is shown below.

Table 3-9

NATURAL GAS: TARGET CASE SUPPLY/DEMAND BALANCE
(trillion Btu)

	1985	1990	1995	2000	2005
Demand	0.0	0.7	4.1	8.6	10.6
Indigenous Supply					
Offshore	0.0	27.5	149.6	238.0	241.6
Coal Gas	0.0	0.7	0.7	0.7	0.7
Total	0.0	28.2	150.3	238.7	242.3
Surplus	0.0	27.5	146.2	230.1	231.7

Source: Nova Scotia Department of Mines and Energy

Box 3-4

SUGGESTED OFFSHORE GAS AND OIL INITIATIVES

Offshore Exploration

Increase liaison with the land departments of offshore operators and potential operators to ensure that exploration opportunities in Nova Scotia are fully appreciated.

In cooperation with the federal government, develop a policy for the expeditious issuance of new lands to ensure maximum access for interested operators.

With the federal government, establish a stable regime for offshore operations, including an attractive generic royalty structure to encourage further exploration, by early revision of the Offshore Oil and Gas Act and the Canada-Nova Scotia Offshore Agreement.

Gain assurances from the governments of Canada and Newfoundland that Hibernia oil production will be allocated to Atlantic refineries.

Onshore Oil

Engage in timely negotiation of onshore exploration agreements with existing license holders, as well as making new lands available on a competitive basis.

Complete the necessary technical studies to correlate existing geological data and to provide a comprehensive overview of onshore petroleum potential.

Natural Gas Liquids

Enter discussions with the federal government to make available the same grants or tax reductions to encourage the use of propane in motor vehicles as are presently available in other areas of the country.

Support a training course to ensure that vehicle conversions take place efficiently, and that vehicles are subsequently properly maintained.

Evaluate Metro Transit's experience with propane as a vehicle fuel.

Study the possibility of converting part of the government vehicle fleet to propane.

Publicize the benefits of using propane as a vehicular fuel.

Consider tax rebates to encourage the conversion of vehicles to propane.

Continue to monitor the feasibility of prebuilding a market for natural gas through the construction and operation of an underground distribution system to supply propane to residential, commercial and industrial users who will eventually be connected to gas services.

Natural Gas

Study the technical aspects of offshore pipelining to ensure that adequate capacity will exist to handle the additional volumes of gas generated by continued exploration.

Undertake discussions with the federal government to ensure that gas marketing assistance is provided in a manner similar to that provided in Central Canada under the National Energy Program.

Update past studies on the manpower required for burner conversions to natural gas in all sectors, and implement appropriate burner and furnace conversion and maintenance training programs.

Provide the body responsible for regulating domestic distribution and marketing of natural gas with sufficient staff support to ensure efficient regulatory review.

Encourage the use of natural gas as a vehicle fuel, possibly using tax rebates or exemptions.

Incremental gas production from the Scotian Shelf will eventually be sufficient to supply the anticipated expansion of the domestic gas service area to the Halifax/Dartmouth area. The remainder will probably be exported to the United States. Incremental offshore production should raise gas supplies to 242.3 trillion Btu in 2005, compared to 68.6 trillion Btu in the status quo forecast.

In addition coal gas is expected to supply 0.7 trillion Btu to the industrial sector in Cape Breton by 1990.

The expected supply/demand balance for natural gas liquids (propane and butane) is shown below. Pentanes plus are dealt with in the crude oil section which follows.

Table 3-10

NATURAL GAS LIQUIDS: TARGET CASE SUPPLY/DEMAND BALANCE
(trillion Btu)

	1985	1990	1995	2000	2005
Demand*	0.8	1.2	1.8	2.7	3.6
Indigenous Offshore Supply	0.0	1.6	8.7	20.6	20.7
Surplus or (Deficiency)	(0.8)	0.4	6.9	17.9	17.1

* Does not include demand for propane and butane produced from refining crude oil. This is dealt with under the refined petroleum product section to follow.

Source: Nova Scotia Department of Mines and Energy

The liquids supply in 2005 of 20.7 trillion Btu increases from 3.8 trillion Btu in the status quo case and will substantially exceed demand, resulting in exports from the province. Pentanes plus are expected to be used as a feedstock in Atlantic refineries. Their use will be discussed with refined petroleum products.

No end-use demand for butane is anticipated, making possible exports or interprovincial shipments.

Coal

Coal remains the province's most available and potentially adaptable indigenous fuel source. Coal plays a major role as a source of primary energy for the production of electricity. As an end-use fuel, however, coal plays a fairly minor role due mainly to its handling problems when used for small-scale (residential, commercial) space and water heating. New initiatives must be taken to stimulate further end-use consumption of domestic coal in Nova Scotia. Such consumption is desirable primarily for the economic development potential and oil substitution effects.

New initiatives are required to encourage the use of new coal handling and consumption technologies, such as fluidized bed combustion and coal-liquid fuels. These technologies offer tremendous potential for stimulating increased domestic consumption of coals. Maximum use of coal for electrical base load generation will continue to be pursued as a means of increasing domestic consumption.

Given the large coal reserves in Nova Scotia, export markets for Nova Scotia coal should be pursued. Such markets provide economic stimulus to the province by generating increased demand. Exporting coal by wire (e.g. coal-fired electrical generation for export) can similarly expand markets for our coal.

On the production side, new initiatives must be taken to ensure that the province is able to respond to any increase in demand. Exploration and mine development must continue at a pace which ensures sufficient supply at the mine mouth. The use of coal washing and blending technologies should be encouraged in order to produce coal which is suitable to a wide range of end-uses. Technologies which convert coal to other end-use fuels (e.g. gasification, liquefaction) can similarly provide increased demand for coal production. Finally, the demethanation of Nova Scotian coal mines can provide a valuable source of natural gas, as well as enhancing the safety of the mines.

The initiatives outlined in Box 3-5, if implemented, can significantly enhance domestic use of Nova Scotia coal.

The coal supply/demand balance is shown below:

Table 3-11

COAL: TARGET CASE SUPPLY/DEMAND BALANCE
(trillion Btu)

	1985	1990	1995	2000	2005
Demand					
End-Use	2.9	3.2	3.7	4.6	5.5
Coke Production	0.0	5.3	5.3	5.3	5.3
Coal Liquefaction	0.0	0.0	1.7	1.7	1.7
Steam and Thermal Electricity	61.1	85.9	108.1	124.8	149.8
Total	64.0	94.4	118.8	136.4	162.3
Supply	81.8	125.0	162.5	175.0	197.2
Surplus available for export	17.8	30.6	43.7	38.6	34.9

Source: Nova Scotia Department of Mines and Energy

Box 3-5

SUGGESTED COAL INITIATIVES

Encourage the development of a new mine by the early 1990s to supply both domestic and export markets.

Continue the activities of the Nova Scotia Department of Mines and Energy Coal Exploration group in order to carry out active exploration programs in the four major coalfields, and to provide the industry with an ongoing evaluation of new information and coal mining opportunities.

Continue Nova Scotia Research Foundation Corporation (NSRFC) development work on the two-stage coal liquefaction process.

Undertake a small demonstration project in a local industrial/commercial plant to demonstrate the economic and technical viability of fluidized bed combustion.

Study the economic viability of establishing a central washing, blending and shipping facility near a deep water port. This would encourage exports by enabling Nova Scotian coal producers to penetrate offshore thermal coal markets with a blend of washed coals consistent with the more stringent coal specifications of foreign markets.

Continue work on the creation of a detailed computerized coal data bank which incorporates all of the existing exploration data and is updated as new data is generated.

Continue research into stable coal liquid fuels, emphasizing the problems of viscosity difference and particle size and distribution differences.

Study the viability of utilizing tailings and fine wash plant rejects in a coal-liquid fuel process.

Continue research into the transportation, freezing and handling problems associated with coal liquid fuels.

Finalize coal gas regulations to provide an attractive and stable regulatory regime.

Negotiate coal gas agreements with the existing license holder in a timely fashion.

Encourage further demethanization projects, and maximize the production of coal gas, where economic.

Study the economics of gasifying some of the province's higher sulphur coals, considering both costs and potential markets.

The target case initiatives will ensure that sufficient mining capacity is available to meet anticipated demand for coal. A new mine, expected to be opened by 1990, will yield a production surplus throughout the forecast period.

Other Fuels

The remaining indigenous end-use fuels expected to play a role in the target case are as follows: coke and oven gas, peat, municipal solid waste and solar power (the use of wind power for electrical generation is covered in the electricity initiatives box on page 126.

The use of coke and oven gas is almost entirely related to the operation of the Sydney Steel Mill. Steel production is assumed to remain constant, and hence the demand for coke and oven gas is likewise assumed to remain relatively stable.

The remaining fuels are not expected to account for more than a total of one percent of the target case end-use demand in 2005. Each offers no possibility for market development outside the province.

Peat

As an indigenous fuel, peat offers attractive economic advantages to Nova Scotia. The technology to produce and consume peat, particularly in the industrial process heating market, has been well demonstrated.

The province's efforts must be concentrated on the production of peat for large industrial consumers who are located in close proximity to the production site. Use in smaller residential and commercial applications is not considered likely due to transportation and economic constraints.

Box 3-6

SUGGESTED PEAT INITIATIVES

Determine the production capacities of peat deposits in the province within reasonable levels of confidence by a harvesting demonstration under average environmental conditions.

Evaluate potential markets for peat fuel and peat products in eastern Canada.

Determine the compatability of existing solid fuel combustion units used or manufactured in Nova Scotia with peat available from southern Nova Scotia.

Establish available reserves using detailed surveys of the most feasible deposits.

Encourage nongovernmental organizations to participate in research that leads to enhanced production capacities from peat bogs, reduced transportation costs and minimized environmental impacts from bog development.

Develop a comprehensive management policy towards Crown owned peatlands to ensure both a fair return to the province and development practices that are both fiscally and environmentally sound.

Compile a bibliography of literature pertaining to peatlands and develop a "user friendly" data base system to allow easy manipulation of the inventory data from earlier studies.

Municipal Solid Waste (MSW)

As is the case with peat, msw offers potential for use as an industrial fuel in large-scale operations. The province must be prepared to encourage such use on a site-specific basis. The following initiatives could be taken:

Box 3-7

SUGGESTED MUNICIPAL SOLID WASTE INITIATIVES

Carry out site-specific feasibility studies, including evaluations of capital cost requirements, equipment options, land availability, available consumers, and cost-benefit implications

Concurrently, study the financing options for municipal waste fuelled energy plants to find those most appropriate for Nova Scotia.

Review the potential of steam production using industrial waste.

Study the possibility of supplementing municipal solid waste with chipped wood in areas of the province which have a suitable customer for the steam which a MSW plant could produce, but insufficient municipal solid waste to support a cost-effective installation.

Solar Power

Solar power is not expected to play a major role either as an electrical production technology or as a space and water heating source. Economic considerations are expected to be the major hurdle. However, where economic, solar installations can help reduce dependence on non-renewable energy sources as well as encourage the domestic solar industry. The following initiatives are suggested:

Box 3-8

SUGGESTED SOLAR AND GEOTHERMAL INITIATIVES

Solar

Continue the Solar Greenhouse Course coordinated by Department of Mines and Energy staff, and assist in updating the course as required.

Monitor developing solar technologies and solar demonstration projects to provide up-to-date information. Undertake additional demonstrations where warranted.

Evaluate the policy of rebating the Health Services Tax on components of active and passive solar systems (expanded in 1984 to include photovoltaic).

Geothermal

Complete a resource evaluation of the geothermal potential in the Springhill area, and if the results are positive, undertake a demonstration project to provide necessary technical and financial information to potential producers.

Assess the potential of geothermal energy in areas other than Springhill.

Residual Fuel Sources

The indigenous fuels described in the target case are expected to account for 66.3 percent of all primary energy in the target case by 2005. While this is an improvement over the 45 percent in the status quo case, a large portion of Nova Scotia's requirements must still come from outside the province. It is anticipated that almost the entire residual requirement will be in the form of crude oil (or refined petroleum products) either from elsewhere in Canada or from international oil markets. The remainder will be minor amounts of imported electricity from New Brunswick.

The anticipated supply/demand balance for oil is shown in Table 3-12.

Table 3-12

OIL: TARGET CASE SUPPLY/DEMAND BALANCE
(trillion Btu)

	1985	1990	1995	2000	2005
Demand					
Sectoral RPP Consumption	122.1	126.9	131.2	133.5	141.5
Electrical Generation	12.1	7.1	4.6	4.0	4.6
Total	134.2	134.0	135.8	137.5	146.1
Supply					
From Coal Liquefaction	0.0	0.0	1.3	1.3	1.3
Required Refinery Production	134.2	134.0	134.5	136.2	144.8
Crude Equivalent	144.3	143.1	143.6	145.2	154.0
From Pentanes Plus	0.0	0.6	22.2	29.7	29.9
From Scotian Shelf Crude	0.0	0.0	7.9	20.9	3.5
Extraprovincial Crude Requirements	144.3	142.5	113.5	94.6	120.6
As a % of Primary Energy Demand	61.0	53.0	38.0	29.0	33.0

Source: Nova Scotia Department of Mines and Energy

Not all of Nova Scotia's requirements will be supplied by crude oil originating from outside Nova Scotia. Coal liquefaction, pentanes plus and Scotian Shelf crude oil are all expected to play a role in reducing our dependence on oil purchased outside the province.

Furthermore, reliance on domestic sources of oil such as Alberta and offshore Newfoundland can further help reduce our dependence on less secure foreign sources.

Target Case Primary Energy Supply/Demand Balance

Nova Scotia's supply/demand balance improves substantially in the target case (see Table 3-13). After 1990, the province produces more energy than is consumed, and thus becomes a **net exporter** of energy (Figure 3-9). In the status quo case, a **deficit** existed over the entire forecast period.

Table 3-13

TARGET CASE: PRIMARY ENERGY SUPPLY/DEMAND BALANCE*
(trillion Btu)

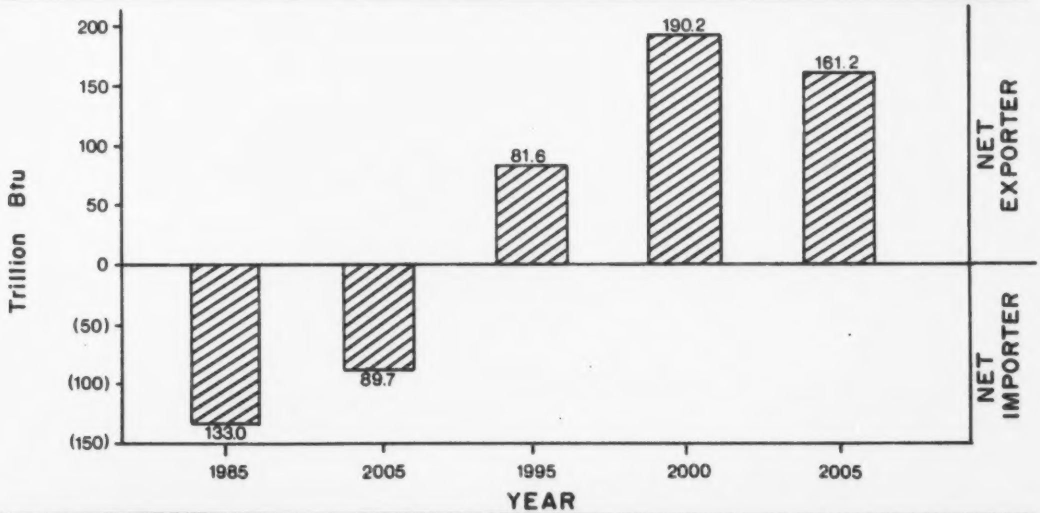
	1985	1990	1995	2000	2005
Production	104.0	181.3	382.5	516.5	525.7
Imports	122.4	144.3	113.9	95.2	121.1
Inter-Provincial Imports	23.7	9.9	7.1	7.1	7.5
Exports	16.9	61.0	186.7	265.5	261.6
Inter-Provincial Exports	1.2	3.5	15.8	26.9	28.2
Total Provincial Supply	237.4	271.0	300.9	326.3	364.5
Requirements	237.4	271.0	300.9	326.3	364.5
Net Surplus** or (Shortfall)	(133.0)	(89.7)	81.6	190.2	161.2

* excluding inventory changes
** production minus requirements

Source: Nova Scotia Department of Mines and Energy

The largest single contributor to indigenous supply in 2005 in the target case is natural gas (242.4 trillion Btu). Coal follows close behind (197.2 trillion Btu), followed by natural gas liquids (50.6 trillion Btu, including pentanes plus), biomass (19.4 trillion Btu), hydro (10.3 trillion Btu), crude oil (3.5 trillion Btu), msw, (1.6 trillion Btu), peat (0.6 trillion Btu) and solar and wind (0.1 trillion Btu). Imports are comprised primarily of crude oil.

FIGURE 3-9 TARGET CASE: NOVA SCOTIA PRIMARY ENERGY SURPLUS (SHORTFALL)[1]



1) Provincial primary energy production minus primary energy demand.
Source: Nova Scotia Department of Mines and Energy.

3.3 SUMMARY AND IMPLICATIONS OF THE TARGET CASE

The initiatives flowing from the target case further the broad objectives of provincial energy policy by improving upon the status quo scenario. If this were not the case, there would be no need for government involvement in energy policy.

Energy supply and demand in the province are brought into balance, although at a different level than that of the status quo case. The more optimistic economic scenario suggested by the target case tends to drive energy demand up, although this is partially offset by heightened energy management measures and is brought into balance through additional energy supplies.

Energy stability improves over the status quo case, as Nova Scotians lessen their dependence on external fuel supplies through the development of their own resources. One broad measure of this success is that the province's dependence on energy produced outside Nova Scotia as a percentage of primary demand is anticipated to fall from 55 percent in 2005 in the status quo case to 35 percent in the target case.

This increased import substitution has two benefits. Less dependence means a reduced risk of curtailment by outside sources which sometimes manipulate the flow of energy for their own political purposes. It also means a larger proportion of fuel expenditures will remain within the provincial economy.

Optimum development of our indigenous resources under the target scenario enables Nova Scotia to become a **net energy exporter**. Economic development is enhanced by the activity associated with developing and producing the resources, as well as through investment by those foreign interests seeking to locate in areas offering stable and diverse energy supplies.

Actions will be taken on the domestic front to optimize our use of indigenous resources. Based on past efforts in energy conservation which were encouraged by government, the target case adds new initiatives which will reduce energy demand by 17.1 trillion Btu over that of the status quo case by 2005. In everyday terms, this translates into a displacement of the equivalent of 3 million barrels of crude oil per year. Not only does this extend the life of our own resources, but it also reduces our dependence on outside sources.

A number of indigenous fuels exhibit considerable potential if certain barriers to their development can be overcome in the target case. An added offshore gas field, expanded use of forest residues, peat bog development, municipal solid waste plants and, to a lesser degree, solar and wind power, will all add to the province's own resource base. Our coal resources are sufficiently large to ensure supply security over the planning horizon of this document.

The Nova Scotia Power Corporation can be counted on to fulfill its mandate to supply adequate levels of electrical power to the province to supply present and future needs. In this regard, numerous additions to the province's power system described in both the status quo and target cases are in the works or on the drawing board.

Even with all these anticipated efforts, we are unable to fully cut our umbilical cord to foreign energy supplies. The largest single source of supply risk lies with foreign crude oil. Even in the target scenario, the province will continue to be dependent on crude oil throughout the forecast period. There are, fortunately, steps that can be taken on the domestic and national front to reduce the amount of foreign crude oil required and lessen the impact of any international shortages that may develop. These initiatives are suggested in Box 3-9.

Box 3-9

SUGGESTED CRUDE OIL SUPPLY INITIATIVES

Encourage exploration and development of petroleum sources offshore Nova Scotia and Newfoundland in order to replace foreign supplies with indigenous.

Encourage the use of east coast offshore oil such as Hibernia oil, in Atlantic refineries. Such oil, while outside Nova Scotia, is much more secure than foreign supplies.

Encourage the use of pentanes plus from any Scotian Shelf gas development as a refinery feedstock replacement for foreign oil.

Monitor international oil markets in order to anticipate future problems.

Request assurances from the federal government that facilities will be constructed to deliver western crude to the East Coast during emergencies.

Update the Provincial Petroleum Emergency Plan to minimize negative impacts on consumers during an emergency

Participate on federal/provincial committees which liase with the International Energy Agency, coordinators of emergency planning in OECD countries.

One point must be reiterated. Efforts to reduce the use of oil because of security of supply problems must be measured against any economic penalties of switching to another fuel. A point may be reached where using oil and bearing any associated supply risks may be considered preferable to switching to a more expensive fuel. Governments can indicate a preference, but this is a decision which consumers must make. Governments' roles are to ensure (1) that sufficient information is available to permit a rational decision; (2) that every effort is made to prevent shortages; and (3) that the negative effects of any shortages are minimized.

Price stability is promoted through the development of indigenous resources as suggested by the target case. While it is difficult if not impossible to translate this stability into numerical terms, one need only look at the impact that reduced energy use and the displacement of OPEC oil by the industrialized nations has had on energy prices. Not only has this resulted in falling energy prices for over six years, but it has also translated into significantly more moderate inflation than was experienced during times of increasing energy prices. From this evidence, it is safe to say that price stability will be enhanced by increased energy self-reliance.

Economic Impacts

Economic development is also enhanced by the target case initiatives directly through resource development and indirectly by improving our investment climate in the eyes of foreign investors.

The economic impact of offshore development has been much discussed and there is no room here to reiterate all the results of the various studies. One thing is certain: offshore activity has had a major impact on the Nova Scotia economy in the past several years and will continue to do so in the foreseeable future.

Table 3-14 illustrates the anticipated Nova Scotia Gross Provincial Product (GPP) in the target and status quo cases. The incremental increase is due, in large part, to the activity associated with the incremental offshore activity. Estimates of job activity associated with this incremental development anticipate a construction employment peak of 1,000 person-years. Continued exploration could account for a further 900 person-years of direct employment over the forecast period.

Table 3-14

ECONOMIC IMPACT OF OFFSHORE DEVELOPMENT
TARGET AND STATUS QUO SCENARIOS

	GPP (1971)$millions			Yearly Growth	Yearly Growth
	1984	1995	2005	1985-1995	1995-2005
Target	3477	4924	6187	3.2%	2.3%
Status Quo	3477	4604	5674	2.7%	2.1%

Source: Nova Scotia Department of Mines and Energy

The importance of coal to the Nova Scotian economy cannot be overestimated. Over 2,600 people are at present directly employed in coal-mining activities with a further 2,000 employed in support roles. With coal production almost 60 percent greater in the target than the status quo case (and twice current levels), it can be anticipated that employment will at least double its present actual level.

Coal production has positive regional effects, since the most direct impacts are felt in Cape Breton. Coal also has strong linkages to the Nova Scotia economy, both backward (such as machinery) and forward (such as coal preparation, transport and processing). Finally, coal resources create an opportunity for Nova Scotia to achieve a position at the leading edge in technologies related to mining, beneficiation, coal-liquid mixtures, demethanation, and coal liquefaction.

Our other indigenous energy options have their own employment and income contributions to the provincial economy. While not as large in absolute terms as offshore gas and coal on a per dollar output basis, they can be expected to generate even larger contributions, mainly due to their labour-intensive nature.

Forest biomass in particular has significant advantages for rural and regional economic opportunities. Even if only 10 percent of the resource base is utilized, this will generate 220 jobs per year, or 4,400 person-years of employment over the 20 year forecast period in harvesting alone. Much of this would occur in the rural areas of the province. Because it involves such a wide range of activities including harvesting, chipping, transportation and consumption, the employment impact increases and is diffused throughout the economy. Hence, a wide variety of small-scale business opportunities arise.

Similarly, peat development could spin off other peat utilization opportunities, and involve harvesting and handling employment opportunities in rural areas which have limited job potential.

Table 3-15 shows the estimated economic impact from operations required to produce the incremental energy production.

While these impacts are only representative examples and do not constitute a comprehensive economic impact assessment of the target case, they do indicate the significant economic benefits associated with that scenario. More in-depth studies of these impacts will be performed at the appropriate date.

An indirect but very real economic development impact of the target case will be the enhancement of our attractiveness to foreign investors. Nova Scotia currently offers many attributes which are important considerations to those searching for an investment location. Examples of these are an abundant supply of skilled labour, excellent transportation links, a strong scientific and engineering community, a stable political system and attractive fiscal regimes. Figure 3-10 indicates the province's favourable location with respect to major world markets. As the indigenous energy resources in the Atlantic region and Nova Scotia in particular are developed, we will be able to add another important attribute to the list - a secure diverse energy mix.

Table 3-15

ECONOMIC IMPACT OF INCREMENTAL WOOD, PEAT AND MUNICIPAL SOLID WASTE, 1985

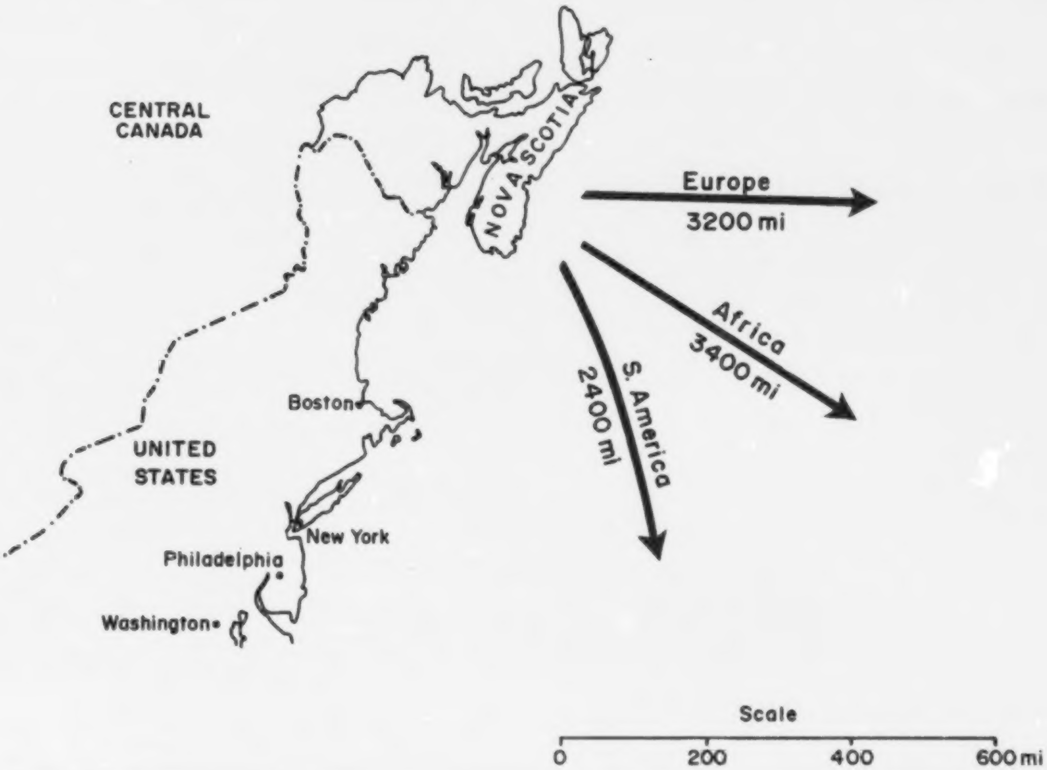
	Capital Cost Total	Annual Operating Cost Total	Direct Operating Employment	Annual Total Household Income (Operating)
Woodchip* Operations	$5.5M	$7.0M	128	$5.7M
Peat	N/A	N/A	22	N/A
MSW**	$15.8M	$2.0M	70	$2.2M

* Expenditures in $1984, assumes all incremental contribution is from woodchip operations
** Expenditures in $1982

Source: Nova Scotia Department of Mines and Energy

The security of energy supplies is becoming a more significant factor in business decisions as organizations face an increasingly volatile world in terms of political stability and energy supply security. Our secure energy supplies will become but one more reason for companies to locate in Nova Scotia.

FIGURE 3-10
NOVA SCOTIA: PROXIMITY TO FOREIGN MARKETS


CENTRAL CANADA
NOVA SCOTIA
Europe
3200 mi
Africa
3400 mi
S. America
2400 mi
Boston
UNITED STATES
New York
Philadelphia
Washington
Scale
0
200
400
600 mi

Environmental Implications

Unacceptable environmental impacts are not anticipated from coal mining in either scenario. Environmental approvals have already been issued for the new Lingan-Phelan mines. Lessons learned during the operating phase of the Victoria Junction wash plant will be applied to the operation of any new washing capacity.

The Nova Scotia Power Corporation, the Nova Scotia and Federal Departments of Environment and the Cape Breton Development Corporation have been working to address environmental concerns associated with an expanded use of coal for electrical energy generation. This effort involves analyzing current environmental conditions, determining the impacts that emission sources will have on Nova Scotia and devising programs to mitigate against adverse environmental effects. These programs include the expansion of washing facilities, and active participation in a program to develop and implement the environmentally superior circulating fluidized bed technology in Nova Scotia. The objective of this work is to realize the sulphur dioxide emission limitations agreed to by the federal and provincial Departments of Environment.

In addition to efforts being made within Nova Scotia, it should also be noted that the federal government and the seven provinces east of Saskatchewan reached an agreement in February 1985 to reduce sulphur dioxide emissions to one-half the emission level of 1980 by 1994. These reductions, particularly in the provinces located west of Nova Scotia, will have a positive environmental impact on Nova Scotia, since about 70 percent of acid precipitation in the province originates in jurisdictions located west and south of Nova Scotia. Any measures taken by the United States in the future will further alleviate the problem, particularly in southwestern Nova Scotia.

The burning of roundwood in residences increases the level of atmospheric pollutants as does coal. To minimize the potential threat to air quality and health, steps can be taken which range from public education on proper installation and use of wood burning devices to limits on the number of wood burning devices. The necessity of such limits is not anticipated in this Plan.

The environmental impacts of harvesting non-commercial species and of removing logging residues for energy purposes are expected to be negligible, provided that proper techniques are used. Detailed study has determined that nutrient depletion of the soil will not be a problem, nor will there be any adverse effect on wildlife habitat. As in any forestry operation, greenbelts must be left near lakes and streams to avoid problems related to erosion and siltation.

The use of msw as a fuel source reduces the area of land necessary for landfill facilities. Because the organic and combustible portions of solid waste are reduced, the sites can be used for other purposes immediately when they are filled upon abandonment. Technology is available to maintain acceptable levels of air emissions from waste incinerators. Other concerns such as dust, noise, odour and traffic must be resolved through careful and thoughtful site selection combined with the application of appropriate pollution abatement techniques.

Venture natural gas and liquids production has already gained environmental impact approval from federal officials and this will also be sought for the new field when the timing is appropriate.

The combustion of natural gas and liquids is environmentally preferable to oil products, coal and biomass. No adverse environmental impacts are anticipated.

Temporary environmental disruption will occur during pipeline construction, but with the application of proper environmental safeguards and mitigation techniques, this should not be of great concern. Proper siting of compressor facilities will reduce noise problems and lessen concerns related to pipeline failure.

The ecological significance of plants in areas where peat is to be developed should be determined before full-scale harvesting is considered.

Conclusion and Course of Action

With recent falling oil prices and supply surpluses, we may have become overly complacent about our energy future. However, international energy pricing and politics remain volatile and unpredictable. As existing reliable non-renewable energy production peaks and begins its inevitable descent, the strategic importance of Middle East oil reserves to the industrialized nations will resurface.

Given the time frame required for energy supply initiatives to be undertaken and to attain their desired results, energy planning by necessity looks to the middle- and long-term. This is the rationale for this document and the forecast period addressed. During this time frame, it is expected that OPEC or a successor cartel will have regained substantial control over traditional crude oil supplies and oil prices will rise.

Therefore this document advocates consistency with the general policy goals outlined in the 1979 Energy Plan. While the time frame may have shifted somewhat, the precepts upon which the Plan was based have not. Energy demand and supply must be brought into balance. Energy stability (including secure supplies of energy at prices that will not injure the industrial infrastructure of the province) must be confirmed. This is to be reinforced by the increased production and utilization of indigenous resources, some of which we have relied heavily upon in the past, others in which the opportunities are now becoming apparent.

Exploitation of these indigenous resources forms the basis of the other major goal - that of the optimum economic development of these resources. But this development must come at a time when the government focus has shifted towards identifying and overcoming barriers, promoting opportunities for private sector energy development and away from performing these roles itself.

Many of the initiatives required to achieve these goals would have been initiated, and in large part realized even without the involvement of the provincial government. This was the basis for the status quo case. By and large, market forces function very well in identifying problems and opportunities, sorting out the best way to approach the situation and doing it. Government must refrain from unnecessary interference with market forces.

Nonetheless, government has a role to play. Government can influence the supply and demand balance through the use of initiatives which will lead to the elimination or reduction of barriers to the increased production and/or optimized management and utilization of those resources.

This is the foundation upon which the target case is built. In a limited way, the provincial government has stepped in to ensure that the public has a clear understanding of the situation, and that the potential of our energy goals is maximized. The target case is a realistic response to the shroud of uncertainties that surrounds energy planning.

The target case forecast translates into a number of initiatives by which the province's goals will be attained. While the plan of action is specific and comprehensive, it leaves sufficient flexibility so that the province may respond swiftly and effectively to international upheavals which will inevitably occur, and possibly distorting energy pricing or supply.

The plan of action is centered upon meeting energy needs by the use of indigenous resources and by efficient energy utilization. Economic development opportunities will be furthered wherever this is reasonable.

Initiatives will be taken in every sector of the economy to inform the consumer how to more efficiently utilize energy and, where expeditious, to aid in bringing about this improvement.

With the goal of doubling coal supplies, initiatives will also be taken to meet the province's growing coal requirements and to further displace foreign crude oil. This means another coal mine will be built, and new consumption technologies will be encouraged to assist in the development of both domestic and offshore markets.

The target case also includes the development of the Venture Gas Project as well as a complementary gas field, so that both domestic and export markets can be served by this versatile fuel source.

Electricity generation will be expanded two-fold to accommodate future growth and new applications. This expansion will be accomplished through the use of our major indigenous resource - coal. The Nova Scotia Power Corporation has demonstrated its ability to construct coal-fired electricity generation plants ahead of schedule and under budget. The Cape Breton Development Corporation has similarly proven its ability to produce sufficient coal for these plants.

Forest biomass opens up a host of opportunities for the application of a vastly under-utilized resource. Already the private sector has moved to realize this potential in a number of ways, and with the assistance of the other initiatives suggested, it is anticipated that the use of forest biomass will increase even further.

Peat and municipal solid waste combustion offer new opportunities although on a somewhat reduced scale. Study is still needed to firmly establish their viability, but the picture looks promising.

Efforts will not stop here. Those technologies and fuel sources with future potential but which have not been included in this Plan must be monitored and pursued. For example, as large-scale tidal power development moves closer to the development stage, it can be included in a future forecasting effort. The same can be said for large-scale coal liquefaction, coal gasification, exports of coal-fired thermal electricity and large-scale efforts to smooth electricity supply peaks.

The province must also remain aware of those technologies which have been identified as unsuitable for the province at this time - for example, wave power and hydrogen fuels. Changing circumstances could elevate such technologies and fuels to a point where their use becomes desirable. The same can be said for any newly discovered fuel sources and technologies.

The provincial government will continue to develop, maintain and update energy data bases and energy forecasting models in order to permit ongoing estimates of energy supply and demand. Documents such as this should also be prepared on a regular basis to promote discussion of energy-related developments.

This document has endeavoured to outline the course of action proposed by the province and the reasoning behind those actions. It is hoped this Plan will encourage an informed dialogue about the problems and opportunities which confront us, the options by which we can further our energy future and the actions best able to realize our goals. A number of issues developed throughout the document seem clear and can set the background for the informed exchange of views that the document is intended to generate. It is now up to those sectors of the Nova Scotia public which have an interest in and concern for energy planning to take the next step.

Part 4.

Appendices

APPENDIX A

COAL RESOURCES - Cumberland County

District		Seam	Thickness (feet)	Dip	Resources (Short Tons)					Proximate Analysis		
					Measured	Indicated	Inferred	Near Surface Resources	Strip Ratio	Ash %	Sulphur %	Calorific Value %
Springhill	North Limb	No. 3	12.0	30°	-	-	34,271,000	167,163	4:1	12.9	1.8	12,249
		No. 1	8.2	30°	-	-	14,962,000	-	-	6.6	2.1	13,430
		No. 2	7.9	30°	-	-	11,842,000	-	-	6.8	1.0	14,149
		No. 7	4.3	30°	-	-	4,545,000	-	-	6.9	1.6	13,134
		No. 6	6.2	30°	-	-	13,937,000	-	-	16.3	1.9	11,837
	Anticlinal Axis	Rodney	6.2	10-15°	4,734,000	-	-	-	-	20.4	2.0	-
		McCarthy	5.6	10-15°	530,322	-	-	-	-	26.4	2.6	9,946
		No. 3	5.6	16°	-	945,783	-	-	-	15.5	3.3	11,783
Saltsprings		Sandrun	3.6	38°	1,146,000	-	-	-	-	29.6	5.5	9,349

COAL RESOURCES - Pictou Coalfield

District	Seam	Thickness (feet)	Dip	Resources (Short Tons)					Proximate Analysis		
				Measured	Indicated	Inferred	Near Surface Resources	Strip Ratio	Ash %	Sulphur %	Calorific Value
WESTVILLE	Acadia	9.5	16°	15,000,000	3,300,000	6,600,000	-	-	14.8	0.8	13,155
	Scott	10	16°	7,850,000	6,876,000	-	-	-	21.8	1.5	11,800
	Third	3	16°	1,900,000	2,400,000	-	-	-	23.2	1.8	11,270
STELLARTON	McLeod	5	23°	-	-	-	40,000	10:1	21.6	0.7	9,840
	Foord	31	23.5°	13,800,000	8,800,000	23,000,000	3,600,000	10:1	26.0	0.5	10,000
	Cage	9	23°	2,000,000	6,000,000	10,000,000	-	-	13.4	1.5	12,296
	Third	7.5	23°	5,000,000	4,000,000	-	39,000	12:1	23.2	1.8	11,270
	Fleming	4.0	23°	198,000	-	-	200,000	10:1	25.1	1.0	10,952
	McGregor	12	23°	5,000,000	6,000,000	3,000,000	200,000	10:1	29.3	1.2	9,838
	New	6	23°	900,000	5,500,000	5,000,000	124,000	10:1	28.4	3.0	11,117
THORBURN	Upper McKay	3.5	20°	-	-	-	760,000	8:1	23.4	1.53	10,542
	Lower McKay	2.5	20°	-	-	-	840,000	8:1	29.0	3.3	9,549

COAL RESOURCES - Colchester County

				Resources (Short Tons)					Proximate Analysis		
District	Seam	Thickness (feet)	Dip	Measured	Indicated	Inferred	Near Surface Resources	Strip Ratio	Ash %	Sulphur %	Calorific Value %
DEBERT	No. 1	4.0	25°-40°	-	800,000	-	-	-	21.9	1.6	10,666
	No. 2	6.0	25°-40°	-	1,300,000	-	-	-	22.1	-	-
	No. 3	4.0	25°-40°	-	800,000	-	-	-	24.2	-	-
	No. 4	4.0	25°-40°	-	600,000	-	-	-	19.3	-	-

COAL RESOURCES - Western Cape Breton

				Resources (Short Tons)					Proximate Analysis		
District	Seam	Thickness (feet)	Dip	Measured	Indicated	Inferred	Near Surface Resources	Strip Ratio	Ash %	Sulphur %	Calorific Value
St. Rose	No. 5	6.7	10° - 30°	1,863,261	1,510,374	-	-	-	7.7 - 12.7	5.9 - 6.5	11,630
Port Hood	6 Foot	2.5 -5.0	15°	-	-	26,800,000	-	-	19.3	9.6	10,735

COAL RESOURCES - Sydney Coalfield

District	Seam	Thickness (feet)	Dip	Resources (Short Tons)					Proximate Analysis		
				Measured	Indicated	Inferred	Near Surface Resources	Strip Ratio	Ash %	Sulphur %	Calorific Value %
POINT ACONI	Pt. Aconi	3.5		-	-	44,000,000	-	-	8.35	5.6	12,000
	Hub	7.4	2.5°	52,029,000	72,973,000	-	-	-	12.9	4.3	12,100
	Bonar	6	4°	-	-	-	600,000	15:1	10.5	5.7	13,100
	Mill Pond	3.5	5°	-	-	-	1,400,000	15:1	18.4	6.0	11,000
	Indian Cove	3	5°	-	-	-	2,600,000	15:1	22.8	7.4	10,600
	Collins (Phalen)	2	5°	1,102,000	-	-	210,000	15:1	11.7	5.1	12,200
SYDNEY MINES	Harbour	5.5	5°	17,857,000	37,479,000	13,338,000	-	-	9.7	3	-
	Phalen	5	5°	7,165,000	16,094,000	2,646,000	-	-	11.7	5.1	12,200
	Lloyd Cove	4.5	5°	-	60,000,000	121,000,000	-	-	7.2	4.9	12,600
NEW WATERFORD	Hub	5.0	5°	7,937,000	21,936,000	73,304,000	-	-	15.0	3.8	13,700
	Harbour	6.1	5°	18,409,000	38,030,000	11,464,000	-	-	5.0	2.0	14,000
	Phalen	7.0	5°	47,951,000	63,383,000	8,157,000	-	-	6.0	2.5	14,700
	Mullins	2.7-6.5	3°-5°	-	78,000,000	-	2,530,000	15:1	12.2	5.0	12,000
GLACE BAY	Harbour	9.7	5°	25,243,000	47,840,000	10,803,000	-	-	9.4	3.8	14,700
	Phalen	5.6	5°	31,306,000	64,375,000	15,873,000	-	-	20.0	4.2	14,200
	Pt. Aconi	6.1	5°	-	-	104,000,00	-	-	6.1	4.4	13,000
	McRury	3	7.5°	-	-	-	479,000	15:1	12	7.7	12,800
	O'Dell	3	5°	-	-	-	1,100,000	15:1	24.0	7.5	-
DONKIN	Lloyd Cove	8.4	5°	369,000,000	190,000,000	-	-	-	10.8	3.9	13,800
	Harbour	9.3-11.7	5°	112,105,000	326,835,000	340,394,000	-	-	10.4	4.2	13,100
	Hub	7.4-8.9	5°	24,692,000	67,682,000	292,994,000	-	-	14.2	5.2	-
	Phalen	5.6	5°	26,786,000	37,479,000	5,952,000	-	-	-	-	-
PORT MORIEN	Spencer	3.1	7°	-	-	-	925,884	10:1	8.5	3.5	13,400
	Tracy	4.0	7.5°	-	-	-	1,147,000	12:1	11.55	6.8	12,648

APPENDIX B

Assumptions — Status Quo Scenario

A. GENERIC
A.1 Economic
- GPP
- Consumption
- Government Expenditures
- Disposable Income
- Unemployment Rate
- Consumer Price Index
- Population

A.2 Offshore Natural Gas Development
A.3 Energy Prices

B. SECTORAL ENERGY DEMAND
B.1 Residential
- End-Use Energy
- Conservation
- Combustion Efficiency
- Public Programs

B.2 Commercial/Institutional/Public Administration
- End-Use Energy
- Conservation
- Combustion Efficiency
- Public Programs

B.3 Transportation
- Efficiencies
- Fuel Market Shares
- Stock Growth and Life Expectancy
- Provincial Programs in Operation

B.4 Industrial
- Conservation

B.5 Exports
- Provincial Programs in Operation

C. ENERGY SUPPLY
- Coal
- Electricity
- Forest Biomass
- Natural Gas
- Liquified Petroleum Gas and Natural Gas Liquids
- Municipal Solid Wastes
- Solar
- Wind
- Geothermal

A. GENERIC

A.1 Economic

(millions of 1971 dollars unless otherwise noted)

	1984	1987	1990	1995	2005
Gross Provincial Product	3447.6	3583.9	3913.0	4604.3	5675.0
Consumption	2621.0	2780.9	3069.4	3535.2	4749.8
Government Expenditure	1106.3	1155.6	1221.2	1201.7	1350.7
Disposable Income	2906.4	3100.6	3451.2	4017.2	5493.0
Unemployment Rate (%)	11.5	12.7	12.7	11.4	8.8
Consumer Price Index (1971 = 100)	287.1	332.6	385.8	538.7	1010.9
Population (000)	859.6	873.4	886.2	905.9	946.6

A.2 Offshore Natural Gas Development

It was assumed that the appropriate fiscal regime is developed and that timely regulatory approvals are received in both Canada and the United States to allow offshore natural gas development to take place consistent with and limited to the Venture Gas Project (VGP). The following scenario was followed:

Production: commences October 1990
Products: sales gas, propane, butane, pentanes plus
Volumes:

	1990	1995	2000	2005
Sales Gas(MMcf/d)	300.5	319.5	319.5	188.0
Propane(bbl/d)	2397.6	2548.6	2548.6	1497.7
Butane(bbl/d)	1900.4	2020.0	2020.0	1189.4
Pentanes Plus(bbl/d)	7765.4	8256.2	8256.2	4858.1

Product Availability:

Sales Gas: Maximum of 20 million cubic feet per day available to the domestic market, a volume which is split evenly between Nova Scotia and New Brunswick. Nova Scotia gas distribution limited to the area surrounding the main transmission line to the U.S. border.

Propane: Venture volumes used to replace central Canadian inter-regional transfers and in new construction only. Remainder available for sale outside the province in eastern Canada and the U.S.

Butane: Due to lack of domestic demand, all butane sold outside Nova Scotia.

Pentanes Plus: Made available to eastern Canadian tidewater refineries as a replacement for crude oil.

A.3 Energy Prices (1985-2005)

World Crude Oil: constant in nominal terms until 1986; increases with inflation 1987-90; 1 percent per annum real increase after 1990.

Canadian Crude Oil: Canadian crude prices equated to landed cost of imports.

Petroleum Product Prices: increased in line with increases in the price of crude oil, to maintain present relationships between products and crude (by sector).

Electricity Prices: subsidy removed April 1986; prices to escalate with inflation.

Natural Gas Prices/Burner Tip: prices to consumers at same Btu discount against fuel oils as currently in place in central Canada. These discounts, assumed to remain constant over the forecast period are as follows: 29 percent below the residential No. 2 oil price; 15 percent below the average No. 2 and No. 6 oil price in the commercial sector; and 5 percent below the industrial No. 6 oil price.

Coal Prices: remain constant in real terms (increase with inflation).

B. SECTORAL ENERGY DEMAND

B.1 Residential

End-Use Energy

Average use per account by type of dwelling (duplex, apartment etc.) by type of end-use (space heat, water heat etc.) was calculated and calibrated to 1983 actual energy demand. Average use was then adjusted for new households in the forecast period for changes in combustion efficiency and conservation (insulation, lifestyle change etc.).

Conservation

Conservation (ie. lifestyle changes and modifications to existing dwellings but excluding improvements in combustion efficiencies) was assumed to account for a 0.8 percent reduction in average use per household per year until 1995. This translates into a total reduction over the period of 9.2 percent.

Combustion Efficiencies

	Average Existing 1983	New Construction 1990	2000
Electricity	100%	100%	100%
Oil	65	80	80
Wood	50	50	50
Gas	—	—	85

Provincial Programs in Operation

- Provincially funded Residential Furnace Efficiency Improvement Program

- Solar greenhouse course

B.2 Commercial/Institutional/Public Administration

End-Use Energy

Average use per commercial establishment by type of end-use was calculated and calibrated to 1983 actual energy demand. Average use was then adjusted for new establishments in the forecast period to account for expected changes in combustion efficiency and conservation.

Conservation

Conservation (ie. all methodologies employed to reduce energy consumption per unit of output excluding combustion efficiency of the capital stock) was assumed to result in a cumulative reduction in average energy use per existing (in 1984) establishment of 2.8 percent by 1995.

Combustion Efficiencies

		Average Existing 1983	New Stock 1990	2000
Natural Gas	(hot water)	--	--	74%
	(sp water)	--	--	80
Electricity		100%	100%	100
LFO/HFO	(hot water)	72	72	72
	(sp water)	70	75	75

Public Programs in Operation

Provincial Energy Analysis Program

B.3 Transportation

Efficiencies

	Gasoline Efficiencies (mpg) 1983	1990	2000
Passenger Cars	26.4	34.9	34.9
Light Trucks	17.3	22.5	22.5
Medium Trucks	7.3	7.5	7.5
Heavy Trucks	6.1	6.3	6.3

	Diesel Efficiencies (mpg) 1983	1990	2000
Passenger Cars	25.9	35.8	35.8
Light Trucks	23.2	29.1	29.1
Medium Trucks	10.4	10.8	10.8
Heavy Trucks	6.9	7.6	7.6

Fuel Market Shares

The percentage of diesel vehicles by class in 1983 was assumed to remain constant through the forecast period.

No natural gas for vehicles was assumed.

Propane consumption in vehicles was assumed to remain constant at the 1983 level.

Stock Growth and Life Expectancy

	Stock Growth (%)	Life Expectancy (yrs)
Passenger Cars	4.1	10
Light Trucks	6.1	13
Medium Trucks	2.0	12
Heavy Trucks	7.0	12

Provincial Programs in Operation

The Federal Department of Fisheries energy audit program for fishing boats will begin during fiscal 1986-1987.

Computerized traffic signals and road widening in the Halifax-Dartmouth area will be instituted.

An additional ferry system in the Halifax-Dartmouth area will be constructed.

B.4 Industrial

Conservation

Realized industrial conservation was expected to account for a 3.1 percent reduction in average energy consumption per establishment (existing in 1984) by the year 1995. This figure translates into a 0.28 percent reduction compounded over 11 years.

B.5 Exports

Provincial Programs in Operation

Continued investigation of the potential to sell coal in eastern Canada.

Continued development of the topping-off concept of coal carriers in the Strait of Canso to enable cheaper water transportation to explore markets.

C. ENERGY SUPPLY

Coal

Nova Scotia's coal mining industry will reach a peak production of 5,142,000 short tons in 1993. This assumption is based on mining taking place at three DEVCO locations: Lingan, Prince and Lingan-Phelan. In addition, production will take place at five other private sector mines.

A new wash plant is assumed to be constructed at either the Prince mine site or the Victoria junction location. Feasibility studies will continue into exploiting both the Donkin-Morien Block and Pictou County deposits and producing a high quality thermal coal by deep cleaning certain coal production.

Access to imported coal is unconstrained except with respect to price.

Electricity

Nova Scotia's ability to supply sufficient electricity to meet demand is unconstrained. New coal-fired thermal plants will be constructed to meet projected demand. Hydro production is assumed to not exceed present capacity of 1030 GWh. Efficiency exchanges with New Brunswick will continue to take place throughout the forecast period.

Forest Biomass

The maximum availability of wood for fuel in Nova Scotia is estimated to be 1.5 million bone dried tons per year.

Natural Gas

Nova Scotia's access to natural gas will be limited to supplies obtained from the VGP (see Offshore Natural Gas Development in this Appendix). Domestic supply from this source is assumed to be a maximum of 20 MMcf/d, of which 10 MMcf/d is expected to be available to Nova Scotia.

Liquid Petroleum Gases and Natural Gas Liquids

The domestic supply of propane will occur from two sources, both constrained. Domestic oil refineries will continue to produce the product but this source is constrained by refinery crude runs. The VGP will produce propane to a maximum of 2548.6 bpd (some or all of which may be consumed in the province depending on price). Any additional demand beyond these sources is assumed to be met through unconstrained imports or transfers from western and central Canada. Canada has removed volume restrictions on imported liquids.

The province will similarly have access to the butane produced by the VGP. This source is assumed to exceed all anticipated demand for butane.

Finally, it is assumed that all pentanes plus produced by the VGP will be made available to Nova Scotia refineries as a replacement for crude oil. Pentanes plus production will reach a maximum of 8256.2 bpd in 1992.

Municipal Solid Waste

Municipal solid waste has the potential to produce a maximum of 38 billion Btu of energy by 1986. This limited supply of energy from this source is constrained by economics and not by physical supply of refuse.

Solar

Energy from solar power is limited to a maximum of 30 billion Btu. This is the result of unfavourable economics of solar projects not subsidized by public funds.

Wind

Wind technology is expected to provide no more than the 1 billion Btu of energy currently produced.

Geothermal

This technology is assumed to be limited to an assessment of the resource potential in the Springhill area and the construction of a demonstration heat recovery project.

APPENDIX C

Assumptions — Target Scenario

A. GENERIC
A.1 Economic
    GPP
    Consumption
    Government Expenditures
    Disposable Income
    Unemployment Rate
    Consumer Price Index
    Population
A.2 Offshore Natural Gas Development
A.3 Offshore Oil Development
A.4 Onshore Natural Gas Development
A.5 Energy Prices

B. SECTORAL ENERGY DEMAND
B.1 Residential
    End-Use Energy
    Conservation
    Combustion Efficiency
B.2 Commercial/Institutional/Public Administration
    End-Use Energy
    Conservation
    Combustion Efficiency
B.3 Transportation
    Efficiencies
    Fuel Market Shares
    Stock Growth and Life Expectancy
B.4 Industrial
    Conservation

C. ENERGY SUPPLY
    Coal
    Electricity
    Forest Biomass
    Natural Gas
    Liquified Petroleum Gas and Natural Gas Liquids
    Municipal Solid Wastes
    Solar
    Wind
    Geothermal
    Peat

A. GENERIC

A.1 Economic (millions of 1971 dollars unless otherwise noted)

	1984	1987	1990	1995	2005
Gross Provincial Product	3447.6	3576.4	3958.5	4924.6	6187.0
Consumption	2621.0	2781.2	3087.2	3598.8	4809.7
Government Expenditure	1106.3	1155.6	1219.8	1292.8	1443.8
Disposable Income	2906.4	3101.0	3472.8	4094.4	5565.8
Unemployment Rate (%)	11.5	12.2	12.0	11.0	7.9
Consumer Price Index (1971 = 100)	287.1	332.6	385.8	538.7	1010.9
Population (000)	859.6	873.4	886.2	905.9	946.6

A.2 Offshore Natural Gas Development

Offshore gas development proceeds as in the base case until 1993. During 1993, an additional 0.5 TCF gas reserve is developed, production which is incremental to and concurrent with the Venture Gas Project (VGP). In 1996, a 1.5 TCF field is developed followed by a 2.0 TCF maintenance field in 2005. The incremental developments are forecast as the result of the analysis of expected exploration activity and discovery rates. Annual product availability is as follows:

	1990	1995	2000	2005
Sales Gas(MMcf/d)	300.5	410.0	650.0	660.0
Propane(bpd)	2397.6	3297.5	8401.0	8501.7
Butane(bpd)	1900.4	2599.0	5600.7	5600.7
Pentanes Plus(bpd)	7765.4	10502.8	14001.6	14102.3

Sales Gas: Maximum 20 MMcf/d available to the domestic market until 1998, a volume which is split between Nova Scotia and New Brunswick. Beginning in 1998, the Maritimes region has access to "unlimited" supplies of natural gas provided by developments incremental to the VGP (ie. the Maritimes' ability to consume gas is less than the volume made available through incremental production). Due to economic constraints, expansion of Nova Scotia's gas distribution system is limited to the construction of a lateral to Halifax which commences operation in 1998.

Propane: Venture volumes used to replace central Canadian inter-regional transfers and in new construction only. Remainder available for sale outside the province in eastern Canada and the U.S.

Butane: Due to lack of domestic demand, all butane sold outside Nova Scotia.

Pentanes Plus: Made available to eastern Canadian tidewater refineries as a replacement for crude oil.

A.3 Offshore Oil Development

Based on drilling history to date on the Scotian Shelf, one crude oil reservoir is assumed to be developed beginning in 1995. Production is assumed as follows:

	1995	2000	2005
Crude Oil(bpd)	7501	19703	3297

A.4 Onshore Natural Gas Development

Coal Seam Demethanation: It is assumed that demethanation of the Lingan coal mine in eastern Cape Breton will produce 2.5 million cubic feet of pure methane per day (2.5 MMcf/d). This gas will be sold to industrial customers in Cape Breton beginning in 1987. This is the only demethanation project anticipated over the forecast period.

A.5 Energy Prices (1985-2005)

World Crude Oil: constant in nominal terms until 1986; increases with inflation 1987-90; 1 percent per annum real increase after 1990.

Canadian Crude Oil: Canadian crude prices equated to landed cost of imports.

Petroleum Product Prices: increased in line with increases in the price of crude oil, to maintain present relationships between products and crude (by sector).

Electricity Prices: subsidy removed April 1986; prices to escalate with inflation.

Natural Gas Prices/Burner Tip: prices to consumers at same Btu discount against fuel oils as currently in place in central Canada. These discounts, assumed to remain constant over the forecast period are as follows: 29 percent below the residential No. 2 oil price; 15 percent below the average No. 2 and No. 6 oil price in the commercial sector; and 5 percent below the industrial No. 6 oil price.

Coal Prices: remain constant in real terms (increase with inflation).

B. SECTORAL ENERGY DEMAND

B.1 Residential

End-Use Energy

Average use per account by type of dwelling (duplex, apartment etc.) by type of end-use (space heat, water heat etc.) was calculated and calibrated to 1983 actual energy demand. Average use was then adjusted for new households in the forecast period for changes in combustion efficiency and conservation (insulation, lifestyle change etc.).

Conservation

Conservation (ie. lifestyle changes and modifications to existing dwellings but excluding improvements in combustion efficiencies) was assumed to account for a cumulative 21.2% reduction in average end-use energy consumption per existing dwelling (in 1984) by 1989.

Combustion Efficiencies

	Average Existing	New Construction	
	1983	1990	2000
Electricity	100%	100%	100%
Oil	65	80	80
Wood	50	50	50
Gas	--	--	85

B.2 Commercial/Institutional/Public Administration

End-Use Energy

Average use per commercial establishment by type of end-use was calculated and calibrated to 1983 actual energy demand. Average use was then adjusted for new establishments in the forecast period to account for expected changes in combustion efficiency and conservation.

Conservation

Conservation (ie. all methodologies employed to reduce energy consumption per unit of output excluding combustion efficiency of the capital stock) was assumed to result in a cumulative 15 percent reduction in average end-use energy consumption per existing (in 1984) establishment by 2005.

Combustion Efficiencies

		Average Existing 1983	New Stock 1990	New Stock 2000
Natural Gas	(hot water)	--	--	74%
	(sp water)	--	--	80
Electricity		100%	100%	100
LFO/HFO	(hot water)	72	72	72
	(sp water)	70	75	75

B.3 Transportation

Efficiencies

	Gasoline Efficiencies (mpg) 1983	1990	2000
Passenger Cars	26.4	34.9	34.9
Light Trucks	17.3	22.5	22.5
Medium Trucks	7.3	7.5	7.5
Heavy Trucks	6.1	6.3	6.3

	Diesel Efficiencies (mpg) 1983	1990	2000
Passenger Cars	25.9	35.8	35.8
Light Trucks	23.2	29.1	29.1
Medium Trucks	10.4	10.8	10.8
Heavy Trucks	6.9	7.6	7.6

Fuel Market Shares

The percentage of diesel vehicles by class in 1983 was assumed to remain constant through the forecast period.

Stock Growth and Life Expectancy

	Stock Growth (%)	Life Expectancy (yrs)
Passenger Cars	4.1	10
Light Trucks	6.1	13
Medium Trucks	2.0	12
Heavy Trucks	7.0	12

B.4 Industrial

Conservation

Realized industrial conservation was expected to account for a 13.6 percent reduction in average end-use energy demand per existing establishment (in 1984) by 2005.

C. ENERGY SUPPLY

Coal

Nova Scotia's coal mining industry will reach a peak production of 7.8 million short tons of saleable coal in 2005. This assumption is based on mining taking place at the three existing DEVCO locations (Lingan, Prince and Lingan-Phelan) and at a new mine to be developed.. In addition, production will take place at five other private sector mines.

A new wash plant is assumed to be constructed at either the Prince mine site or the Victoria junction location. Feasibility studies will continue into exploiting both the Donkin-Morien Block and Pictou County deposits and producing a high quality thermal coal by deep cleaning certain coal production.

Access to imported coal is unconstrained except with respect to price.

Electricity

Nova Scotia's ability to supply sufficient electricity to meet demand is unconstrained. New coal-fired thermal plants will be constructed to meet projected demand. Hydro production is assumed to not exceed present capacity of 1030 GWh. Efficiency exchanges with New Brunswick will continue to take place throughout the forecast period.

Forest Biomass

Waste and roundwood for fuel available from the harvesting of merchantable wood (in non-energy uses) will equal almost 1.5 million bone dried tons annually. In addition, a "one-time" supply of 18.7 million bone dried tons is currently available in the form of diseased trees, unmerchantable species, etc.

Natural Gas

Nova Scotia's access to natural gas will be limited to supplies obtained from the offshore (see Offshore Natural Gas Development in this Appendix) and from the demethanation of coal seams (see Onshore Natural Gas Development in this Appendix). Domestic supply from these sources is assumed to be a maximum of 22.5 million cubic feet per day until 1998, of which 12.5 MMcf/d is expected to be available to Nova Scotia. Beyond 1998, gas supply to the domestic market is assumed to be unlimited as incremental developments in the offshore take place.

Liquid Petroleum Gases and Natural Gas Liquids

The domestic supply of propane will occur from two sources, both constrained. Nova Scotian oil refineries will continue to produce the product (1984 production equalled 1120.8 bpd) but this source is constrained by refinery crude runs. The development of offshore gas will produce propane to a maximum of 9200 bpd in 2001. Any additional demand beyond these sources is assumed to be met through unconstrained imports or transfers from western and central Canada. Canada has removed volume restrictions on imported liquids.

The province will similarly have access to the butane produced by the offshore development. This source is assumed to exceed all anticipated demand for butane.

Finally, it is assumed that all pentanes plus produced by the VGP will be made available to Nova Scotia refineries as a replacement for crude oil. Pentanes plus production will reach a maximum of 15,200 bpd in 2001.

Municipal Solid Waste

Municipal solid waste consumption will produce a maximum of 1.6 trillion Btu of energy in 2005. Sufficient refuse production is available to produce this level of energy.

Solar

Energy from solar power is limited to a maximum of 95 billion Btu. This is the result of unfavourable economics of solar projects not subsidized by public funds.

Wind

Wind technology is expected to provide no more than the 9 billion Btu of energy currently produced.

Geothermal

This technology is assumed to be limited to an assessment of the resource potential in the Springhill area and the construction of a demonstration heat recovery project.

Peat

Peatlands in Nova Scotia currently hold 617 million cubic yards of moss grade peat and 420 million cubic yards of fuel grade peat.

Production of peat for fuel purposes will reach 51,800 short tons per year by 1995. Reserves are sufficient to allow production far beyond this level.

APPENDIX D

Conversion Factors

	Barrels (Petroleum)	Metric Tonnes	Short Tons	Gallons 1,000	Cubic Metre
Barrel (Petroleum)	1.0	0.135	0.148	0.035	0.159
Metric Tonnes	7.428	1.0	1.102	0.259	1.180
Short Tons	6.740	0.907	1.0	0.236	1.071
1,000 Gallons	28.571	3.857	4.229	1.0	4.546
Cubic Metre	6.293	0.850	0.931	0.220	1.0

Energy Units

1 Btu = 1.0546 kilojoules or kJ
1 thousand Btu = 1.0546 megajoules or MJ
1 million Btu = 1.0546 gigajoules or GJ
1 billion Btu = 1.0546 terajoules or TJ
1 trillion Btu = 1.0546 petajoules or PJ

Fuel	Measurement	Btu (Million)
Coal, Nova Scotia Bituminous (average)	Short Ton (2000 lb.)	25.2000
Coal, Sub-Bituminous	Short Ton	17.0000
Lignite	Short Ton	13.2000
Crude Oil	Barrel	5.8030
Motor Gasoline	Gallon	.1492
Light Fuel Oil	Barrel	5.8275
Heavy Fuel Oil	Barrel	6.2874
Natural Gas	Mcf (thousands of cu.ft.)	1.0000
Electricity, Use	MWh	3.4120
Electricity, Output	MWh	10.0000

NOTE: Conversions rates often vary, depending on the condition and quality of the fuel being considered.